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PAPERS AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

TASMANIA,

FOR

1886.

TASMANIA

PRINTED AT "THE MERCURY" OFFICE, HOBART.

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THE responsibility of the statements and opinions given in the following papers and discussions, rests with the individual authors; the Society as a body merely places them on record.

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ERRATA AND ADDENDA

P. xiv. l. 42. For "*Nova*" read "*Novus.*"

P. xiv. l. 51. For "Areas" read "Arias."

P. xv. l. 47. Read 3. "Map of the Indian Ocean from Cape Comorin to Aimoey Bay in China."

P. xvi. ll. 6-7. Delete "of Java."

P. xvi. l. 7. For "maps" read "map."

P. xvii. l. 23, "libegio vento." The S.W. wind is called *Lebeches* by the Spaniards, and *Libeccio* by the Italians. Bedford's *Sailor's Pocket Book*, p. 418.

P. 185, l. 34. For "5. 413" read "5413."

The receipt of a work by L. C. D. van Dijk, entitled "*Mededeelingen uit het Oost-Indisch Archiev., No. 1. Twee Togten naar de Golf van Carpentaria,*" enables me to withdraw the hypothesis which I advanced regarding the date of the discovery of d'Edel's Land in the volume for 1885, p. 407. The d'Edel of 1617 was a Cornelis d'Edel, whose abortive voyage was quite distinct from that of 1619, in which his brother Jacob d'Edel, with the ship *('t Wapen van (?)) Amsterdam*, fell in with the west coast of Australia in 32½deg. S. lat. (July 19) (bl, vii.-viii.)

Lauts informs us that Carstens (1623) named the Gulf of Carpentaria in honour of the Governor (Landvoogd) of that name. *Nederlanders in Indië*, bl. 214.

ERRATA.

Page 242, Order Fulicariæ, *for* "Blue Coat" *read* "Blue Coot."
Page 243, Order Gaviæ, *for* "Hollandæ" *read* "Hollandiæ."
Page 244, Order Ansores, *for* "Bernida" *read* "Bernicla."
Page 245, Order Herodiones, *for* "Hollandæ" *read* "Hollandiæ."

PROCEEDINGS.

APRIL, 1886.

The members of the Royal Society of Tasmania commenced their session for the year 1886 at the Museum building on April 13. Mr. James Barnard, vice-president, occupied the chair, and there were also present the Acting-Chief Justice (His Honor Mr. Giblin), the Premier, Dr. Agnew (who has acted as honorary secretary of the Society for many years), the Minister of Lands (Hon. N. J. Brown), and a fairly large number of ladies and gentlemen, 42 Fellows being present.

ELECTIONS.

The following gentleman was elected corresponding member of the Society :—Baron von Groddeck, of Germany.

The Revs. Geo. W. Shoobridge and G. F. M. Fielding, M.A., were elected Fellows of the Society.

CHAIRMAN'S ADDRESS.

The CHAIRMAN said : I need scarcely remind the Fellows of the Society that we have commenced this session under altered conditions and circumstances, and that since our last meeting effect has been given to the provisions of the Act of Parliament for transferring the control of the Museum and Botanical Gardens from the Royal Society to a board of trustees. This change, however, is more nominal than real, for the trustees have been derived largely from our own governing body. Besides, there is the additional advantage of a blending in the person of Mr. Morton of the dual positions of assistant secretary and librarian of the Royal Society with that of curator and secretary to the Museum ; and, moreover, our highly esteemed honorary secretary and senior vice-president (Dr. Agnew) has been elected to be chairman of the board of trustees. Hence it is evident that the interests of the Royal Society are in safe keeping, and that we may fairly expect that the same intimate relations will continue to subsist as heretofore between the now two distinct bodies. For instance, any specimens presented to the Royal Society, in the illustration of papers or otherwise, will be ultimately deposited in the Museum, and, conversely, all contributions direct to the Museum, will be exhibited on our table at the monthly meetings of the Fellows of the Royal Society.

Although this has not yet been settled by the board of trustees, yet it will, no doubt, be considered mutually advantageous in the interests of science, that the descriptions of the presentation to the Museum, as well as a list of the exchanges of plants and seeds at the Botanical Gardens, should be published as heretofore in the "Papers and Proceedings of the Royal Society," and thus sustain the interest of that valuable publication.

CONTRIBUTIONS.

The HON. SECRETARY (Dr. Agnew) read the following list of contributions to the Library since the last meeting :—

Adelaide University Calendar for the Academical Year 1886 (bound), from the University.

Agriculturist Gazette, current numbers. *American Agriculturist*, do.

Annals and Magazines of Natural History, December 1885, January and February 1886.

Annual Report of the Surgeon-General United States Army, 1885, from the Department.

Annual Report Launceston Mechanics' Institute, 1885, from the Institute.

Annual Report of the Museum of Comparative Zoology at Harvard College for 1884-5, from A. Agassiz.

Anzeiger der Kaiserlichen Akademie der Wissenschaften, Nos. 1 to 28, 1883, Nos. 1 to 28, 1884, Nos. 1 to 21, 1885, from the Society.

Beiblatt Zu den Mittheilungen des Ornithologischen Vereines in Wein, 1 Jany, Nos. 1 to 28, June 21 to December 28, Nos. 1 to 12, 1884, Nos. 1 to 19, 1885, from the Society.

Boletim da Sociedade de Geographia de Lisboa, Nos. 1, 2, 3, 4, 5, 5A, Serie 5A, Serie No. 6, from the Society.

Bulletin de la Societie de Geógraphié, 7 Serie Tome VI., 1er. 2, 3, and 4er. Trimistie, 1885, from the Society.

Bulletin de la Societe Imperiale des Naturalistes de Moscow, No. 4, 1885, from the Society.

Bulletin of the American Museum of Natural History, Vol. I., No. 6, from the Society.

Bulletin du Musée Royal D'Histoire Naturelle de Belgique, Tome IV., No. 1, from the Society.

Catalogue of Minerals in the Australian Museum, by A. Felix Ratte.

Catalogue of the Echinodermata, in the Australian Museum, by E. P. Ramsay, LL.D. (bound), from the trustees.

Catalogue of the contents of the Museum of the Royal College of Surgeons, London, Pt. 1, 4 and 5 from Mrs. W. L. Crowther.

Catalogue of specimens of Mollusca, for sale, by H. A. Ward.

Condition of Climatological Observations over the Globe, by R. H. Scott, M.A., from the author.

Contributions to Canadian Palæontology, Vol. 1, Pt. 1.

Report on the Invertebrata of the Laramie and Cretaceous Rocks in the vicinity of the Bow and Belly Rivers, and adjacent localities in the North-west Territory, from the Society.

Cuvier's Natural History, Reptiles, Fish, Crustacea, Insects, vols. 1, 2, from Mrs. W. L. Crowther.

Descriptive Catalogues of the Osteological Series contained in the Museum of the R.C. of Surgeons, England, Mrs. W. L. Crowther.

Descriptive Notes on Papuan Plants, by Baron F. von Mueller, K.C.M.G., from the author.

Entomologisk Tidskrift, Arg 6, Häft 1, 3, 4, from the Society.

Gardeners' Chronicle, current Nos., Geological Magazine, January and February. Imperial Federation, Vol. 1, Nos. 1-2, January and February, 1886, from the Editor. Indian Meteorological Memoirs, Vol. 2, Pt. 5, from the Dept.

Journal of Conchology, Nos. 6, 7, 8, 1884, Nos. 9, 10, 11, 1885.

Journal of the Society of Arts (current Nos.).

Journal of the Royal Microscopical Society, December, 1885, also Supplement No. containing Index, February No., 1886, from the Society.

Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1884, from the Governor-in-Council.

Memoranda on Vegetation, by J. Hunter, from Mrs. W. L. Crowther.

Meittheilungen des Ornithologischen Vereines in Wien, 9 Jahrg No. 20 to 32, 10 Jahrg, No. 1, from the Society.

Monthly Notices of the Royal Astronomical Society, Vol. 46, No. 9, Vol. 46, No. 1, 2,3, from the Society.

Monthly Weather Report of the Meteorological Office, London, for May 1885. Official No. 65.

Weather Report for 1884, from the Department.

Monthly Record Meteorological Observations, July 1885, Melbourne, from the Government Astronomer.

Nature (current Nos.), Naturhistorisches Museum der Staat, Strassburg, from the Society.

Observations made at the Magnetical and Meteorological Observatory at Batavia, Vol. VI, Part 2, from the Government.

On an Extinct Type of Dog, from Ely Cave, Lee County, Virginia. Plates, by J. A. Allen, from A. Agassiz.

Proceedings of the Academy of Natural Sciences of Philadelphia, Pt. II., April to July, 1885, from the Society.

Proceedings of the Zoological Society of London, Pts. 1, 2, 3, 1869, from the Society.

Provincial Medical Journal, Vol. 5, 49, from the Editor.

Professional Papers of the Signal Service, No. XVI., Tornado Studies for 1884, No. XVIII., Thermometer Exposure, from the War Dept., Washington.

Records of the Geological Survey of India, Vol. XVIII., Pt. 4, Vol. XIX., Pt. 1, 1886, from the Dept.

Reports on the results of dredging, under the supervision of Alex. Agassiz, in the Gulf of Mexico, 1877-8, in the Caribbean, 1878-9, and along the Atlantic Coast of the U.S. during the summer of 1880, by the U.S. Coast survey steamer, "Blake."

XXVIII., Report on the Specimens of bottom deposits, by J. Murray, from A. Agassiz.

Report of the Zoological Society of London, 1869-72-76-79-81, from the Society.

Report of the Mining Registrar for the quarter ended 31st December, 1885, from the Dept.

Statistical register of the Colony of Victoria, 1884, Pt. VIII., IX., from the Government.

Societé de Geographié, Nos. 16 and 17, 1884, Nos. 19 and 20, 1885, Nos. 1, 2, 3, 4, 1886, from the Society.

Seventh annual report of the Proceedings of the Government Statist in connection with Friendly Societies, report for the year 1884, to which are appended valuations of Friendly Societies, statistics of Friendly Societies, from the Government Statist, Victoria.

Tornado Studies for 1884, No. XVI., Thermometer, exposure, No. XVII., from the Signal Office, U.S.

Transactions of the Royal Historical Society, new series, Vol. III., Pt. I., from the Society.

Transactions of the Asiatic Society of Japan, Vol. XIII., Pt. II., 1885, from the Society.

Transactions of the Zoological Society of London, Vol. VI., Pt. VIII., Vol. VII., Pts. 1 and 2, from the Society.

Victorian Naturalist (current Nos.) from the Society.

Verhandlungen des Naturhistorisc hen, Vereines der prenssischen, Rheinlande und Wesfalens, Eiste halfte, Ziveite halfte, 1884, from the Society.

Verhandlungen der Gesellschaft, Fü Erkunde Zu Berlin, B and XIII., No. I., from the Society.

Victorian Year Book for 1884-5, by H. H. Hayter, C.M.G., from the author.

Dr. AGNEW said he thought the Fellows would see from this list that they derived contributions to their Library from a very large range of Societies in various parts of the world.

NEW ZEALAND ALPS.

In reference to the paper on the geology of the New Zealand Alps, by Professor F. W. Hutton, of the Christchurch (N.Z.) University, which had been announced to be read,

Dr. AGNEW said the writer of this paper was a corresponding member of the Society. He was sorry to hear from the Curator that the name of Professor Hutton appeared in the list of people drowned by the wreck of the steamer Taiaroa on the coast of New Zealand. The news might not be true, but if it were it would give a melancholy interest to the paper, which was probably one of the very last he had written. The hon. gentleman then read the paper, which was of a very interesting and comprehensive character.

Mr. JOHNSTON made some remarks in harmony principally with Mr. Hutton, and said the information given would be very serviceable to the Fellows in relating the rocks of Tasmania to those of New Zealand. He also referred at some length to a former paper of his own for the purpose of showing the equivalents of New Zealand rocks in Tasmania.

NOTES ON THE GEOLOGY OF BRUNI ISLAND.

Mr. R. M. JOHNSTON read a paper on this subject which gave a general description of the geology of North and South Bruni. In character and relation the rocks are similar to those already described by him in a section between Blackman's Bay and Pearson's Point, and indeed Bruni Island is stated to be a simple prolongation of that spur. The most interesting part of the paper, however, is that in which Mr. Johnston announces the discovery that the coal seam at Adventure Bay belongs to the lower coal measures, and not to the Mesozoic coal measures as hitherto supposed. Thus the Adventure Bay coal belongs to the same horizon as the Mersey coal measures, the Bacchus Marsh sandstones, and the lower coal measures of Greta and Stony Creek, New South Wales. The coal measures at Adventure Bay are described as resting comformably upon the upper beds of marine mudstones of upper palæozoic age, and contain the characteristic plants of the lower coal measures, viz., Glossopteris Browniana, Gangamopteris spathulata, G. obliqua, etc. No single plant of the Mesozoic coal measures could be found. With respect to the conglomerate beds of the upper marine formation, Mr. Johnston commented upon the absence of organic life in many of the members, and suggested the possibility of the barrenness being due to the lowered temperature of a glacial period, of which there are evidences in various parts of the world towards the close of the palæozoic era. The transport of huge erratic blocks of granite over a ton in weight and other rocks not now found in the vicinity favour the hypothesis of glacial influence. Mr. Johnson gave a complete list of all the fossils of the Upper Palæozoic Marine Beds of Tasmania known to him, together with descriptions of 18 new species of fossil molluses. He also gave a description of the coal seam at Old Beach now being developed by Mr. A. Brock. This seam belongs to the coal measures of mesozoic age, and the formation in which the seam occurs is identical with that exposed at Constitution Hill. The coal is similar in quality to that at Gardener's Bay. The paper was illustrated by drawings of sections.

Mr. SPRENT followed with some remarks in which he recognised the investigations of Mr. Johnston as having settled a very important point so far as the southern part of the island was concerned.

ORNITHOLOGY.

Colonel LEGGE read a portion of a paper illustrative of a catalogue of the birds of the Colony which he had in course of preparation.

Mr. R. M. JOHNSTON congratulated Colonel Legge on his undertaking a work which would be of so much interest to the ornithologists of the Colony.

OYSTER CULTURE.

Mr. SAVILLE-KENT produced some specimens showing his success in oyster culture at Oyster Cove. These were grown on split palings, covered with cement. He also exhibited a young salmon taken by a fisherman in the Mersey, and which showed how they were thriving in that locality.

Dr. E. L. CROWTHER hoped the Government would carry on oyster culture on a large scale, and induce a large export trade for the Colony.

Mr. KENT said the Government had made provision for larger experiments during the coming season.

SUN SPOTS.

Mr. J. R. MCCANCE, F.R.A.S., produced some photographs by Mr. Pickering, of the Lands Department, taken from sketches of sun spots, as seen by Mr. McCance at the observatory on January 16. He advocated the Government getting a 10in. reflector from England at a cost of £250, so that they might study astronomy as well as meteorology. The present telescope was a good little instrument, but it was not half large enough.

SNAKES.

The CURATOR read a letter from the Rev. H. R. Atkinson on the subject of what he believed to be a new species of snake which he had found near the mouth of the river Arthur. Mr. Morton stated that, after a very careful examination of a number of specimens he was of opinion that it was not all improbable that other species than the three already known as being found in Tasmania would be found, he had written to several persons in different parts of the Island, asking them to forward to the Museum any snakes they might capture, so that a careful examination might be made.

Mr. SWAN doubted if a new species would be found in Tasmania beyond the three kinds now known. Variations in colour in those kinds were caused by climate and locality.

Mr. JOHNSTON stated that he had considerable advantage in observing the snakes in nearly all parts of Tasmania, but he only knew of three species, which vary considerably in colour. It was quite possible, however, that more careful examination might disclose other species than those now known to science.

EXHIBITS.

A collection of New Guinea Butterflies, collected and presented to the Museum by Lieut. Lucas, R.N., H.M.S. Raven, was greatly admired.

The CHAIRMAN drew attention to a box presented by Lady Wilson, made from the warship *Gibraltar*, 80 guns.

The CURATOR stated that during the past month Mr. Vimpany had captured a black snake *(Hoplocephalus curtus)* at Longley, measuring about 4ft. 3in. in length. On opening it the unprecedented number of 109 young ones were found in her. The specimens now before the meeting are the largest ones, the measurement being from $8\frac{1}{2}$in. to $\frac{3}{4}$in. in length. Mr. Morton stated that the greatest number he had known previously to be taken from a similar snake was 32, but he had been informed by a resident of Tasmania that over 70 had been taken from a similar species.

A vote of thanks to the donors of presentations to the Museum, and to the readers of papers and speakers of the evening, was accorded, on the motion of Mr. JUSTICE GIBLIN, seconded by Mr. A. G. WEBSTER.

This terminated the proceedings.

MAY, 1886.

The monthly meeting of the Society was held on Tuesday, May 18, at the Museum. Lieut. C. E. Beddome (I.N.) in the chair.

The following gentlemen were elected Fellows of the Society, viz.:—Rev. J. Dillon, curate at St. George's, Lieut. Farrell, and Mr. E. R Ash.

Owing to important official engagements the hon. secretary (Hon. Dr. Agnew) was unable to be present. The assistant secretary brought forward the usual returns, viz.:—

List of additions to the library during the month of April :—

A Synopsis of the Queensland Flora, containing both the Phœnogamous and Cryptogamous plants. First supplement by F. M. Bailey. Pamphlets.—From the author.

Annals and Magazines of Natural History.—March.

Annales de la Société Malacologique de Belgique. Tome XV. Deuxiéme Sério. Tome V. Fascicule 1. Année 1880.—From the Society.

Annales de la Société Royal Malacologique de Belgique. Tome XIX. Troisiéme Série. Tome IV. Annie1884.—From the Society. Annalen des K.K. Naturhistorischen Hofmuseums redigirt, Von Dr. Franz, Ritter Von Hauer. Band 1, No. 1.—From the Society.

Athenæum, February.

Boletim da Sociedade de Geographia de Lisboa, 5th Serie. No. 7, 8.—From the Society.

Catalogue of the indigenous woods contained in the Queensland Court, Colonial and Indian Exhibition of 1886, with a brief popular description of the trees, their distri ution, qualities, uses of timber, etc., etc.—By F. M. Bailey, F.L.S.

Classified index of the indigenous and nauturalised plants of Queensland, with an alphabetical index of genera of the first part of the work. Pamphlets, by F. M. Bailey, F.L.S.— From the author.

Catalogue of the Fossil Mammalia in the British Museum (Natural History), Pt. II. containing the order (Ungulata, sub-order Artiodactyla). —By R. Lydekker, B.A., F.G.S.

Catalogue of the Palæozoic Plants in the British Museum.

Catalogue of the lizards in the British Museum (Natural History, second edition), by George Albert Boulenger, Vol. II. Iguanidæ, Xenosauridæ, Zonuridæ, Arguidæ, Anniellidæ, Helodermatidæ, Varanidæ, Xanthusiidæ, Teridæ, Amphisbænidæ (bound.—From the Trustees British Museum.

Geological Magazine April.

Imperial Federation, No. 3, Vol. I. March, 1886.—From the Editor.

Journal of the Society of Arts, Feb. 5, 12, 19, 26.

Memoirs of the Geological Survey of India. Palæontologia Indica, Sec. XIII. Salt-range Fossils, by William Waagen, Ph.D. 1. Productus —Limestone Fossils. 5. Bryozoa—Annelida—Echinodermata, with plates. LXXXVII—XCVI. —From the Dept.

Nature. February.

On the comparative temperature of the Northern and Southern Hemispheres of the Earth—On the geometrical construction of the cell of the honey bee—On the figures of the Planets. By Prof. Henry Hennessey, F.R.S. Pamphlets. From the Author.

Proceedings of the Linnean Society of New South Wales. Vol. X., Pt. 4. Also record of Proceedings.—From the Society.

Proceedings and Transactions of the Royal Society of Canada for the year 1884. Vol. II., bound.—From the Society.

Proces-Verbaux des Seances de la Société Royale Malacologique de Belgique. Tome XIV. Annee 1885.—From the Society.

Société deGéographie, No. 5-6, 1886.—From the Society.

PAPERS.

Mr. Bastow then read a paper on the *Peronospora infestans*, or potato disease, in which he pointed out the life history of this destructive fungus. Having alluded to Messrs. Cooke, Berkeley, De Bary, and more especially to Mr. W. G. Smith as having worked most assiduously on this subject. He stated that when the potato plant is attacked by the fungus the leaves assume a pale tint, become spotted, and are covered with white mealy patches on the under surfaces. The plant quickly withers, and the spores formed within it spread destruction over the whole field. Examined by the microscope the white patches present a beautiful appearance, something like a miniature crystal forest, with each branch bearing fruit. When the fruit cases open, *zoospores* are scattered right and left, these have the power of motion, and working their way into the fluids of the plant, their cilia drop off, and the *zoospore* (to all appearances a minute member of the animal kingdom) at once begins to throw out *mycelium* threads and fertile stems, once more bearing fruit. They propagate also by resting spores, these resting spores being *oginia* that have been fertilised by having almost wholly absorbed *antheridia*. Slides, containing specimens of the potato plant infested with this fungus, were shown under the microscope with an eighth of an inch objective. The fertile stems had all the appearance of small hyaline trees, the branches being simple or with short branchlets. The *zoospores* could be made out as they rested in their fruit cases. De Bary states that 19,620 of these *zoospores* are contained in one square line, so that there need be no surprise that acres of potatoes are destroyed in so short a space as 48 hours.

Mr. SHOOBRIDGE said he never knew, in his experience, of that disease in Tasmania.

Mr. JOHNSTON asked if this disease had appeared to any extent in Tasmania.

Mr. SHOOBRIDGE said it had not appeared in his district, and he had not heard of it having broken out in the colony.

The CHAIRMAN: I don't think it is known in this colony.

Mr. STEPHENS: It is to be hoped that it never will be.

Mr. SHOOBRIDGE: It is similar to the Irish blight.

Mr. BASTOW: Yes.

Mr. SHOOBRIDGE said that the only disease he knew in Tasmania affected the tubers only.

Mr. STEPHENS said there was a disease among the potatoes in the colony which required investigation, because its history and origin was not very well known.

Mr. JOHNSTON suggested that Mr. Bastow be asked to examine some of these diseased potatoes, and bring a paper before the society on the subject.

Mr. STEPHENS said that a peculiar characteristic of this disease was that it was always accompanied by a peculiar change in the weather, weakening the plant and rendering it more susceptible. He was in England all through the potato blight, and he found that the only soil where potatoes would grow free of disease was a sandy ground. The only place which he knew where the potato blight did not extend was on a cultivated beach at Morecambe Bay, which was little more than sand, but, of course, was strongly impregnated with salt. He hoped, however, that they would not get the disease in Tasmania.

Mr. JOHNSTON said that in the north highlands of Scotland many large tracts of land which had at some recent period been covered by the sea were planted with potatoes. The potatoes grew better on a shingly beach than anywhere else, and those grown inland were found to be more affected with disease.

Mr. SHOOBRIDGE said that might be accounted for by more silica being taken up, and causing a hard substance on the leaf. The same fact was noticed with rust in wheat, and where there was more silica in land the plant was harder, and was not affected in the same way.

Mr. BASTOW said that he first studied peronospora infestans when he was in Manchester. They had a large quantity of manure to get rid of, and wanted to get a market for it. The soil round Manchester was very heavy, and the disease at that time was creating very great havoc among the potatoes. They allowed a few of the market gardeners to try this manure, and it was found that it was better than horse dung, and the potatoes were comparatively free from disease.

LONGFORD COAL.

An interesting paper was read by Mr. R. M. Johnston, F.L.S., on the Longford coal. The paper was illustrated by diagrams, and he dealt with the various seams worked up to the present, giving analysis prepared by Mr. W. F. Ward, Government analyst, of a sample of the coal.

Discussion took place, and Mr. STEPHENS spoke favourably of the Norwich coal measures; but deprecated the waste of money in boring for coal without sufficient data to go upon, or any reasonable prospect of satisfactory result.

EXPLANATION.

Mr. Abbott, superintendent of the Botanical Gardens, wrote stating that a telegram from Melbourne that appeared in *The Mercury* of the 6th April *re* evidence given by him before the Royal Commission on Vegetable Products, "viz., that fruit-growing in Tasmania was on the decline," was incorrect. The answer regarding the fruit-growing in Tasmania, given by him, was as follows :—That we grew fruit extensively. That orchard ground had a special value. That the area under fruit had increased greatly during the last few years. That fruit trees were still being planted largely. That the ordinary jam-making was the only mode of preserving at present practised, the American process of drying would no doubt come in time, as over-production would lead to it. That during the last year or two there had been over-production, especially in small fruits, more particularly raspberries. That some of the older orchards were dying out, and that he was of opinion that many would do so if only on account of the codlin moth that had got such a hold of them. That except some of the districts having declared themselves to be clean, the Codlin Moth Act was at present a dead letter. That he did not think vine planting in Tasmania was on the increase except at Maria Island, where large numbers had been put in with good prospects. That no doubt some parts of Victoria would be found equally suitable for the production of fruit as Tasmania; but that, speaking as a whole or generally, he was of opinion that the hot winds would interfere with its successful production." The above from memory is the gist of the evidence given on fruit growing as applied to Tasmania.

Mr. SHOOBRIDGE said that the trees in his locality had a tendency to be very short-lived. Orchards planted 14 or 15 years ago have seriously decreased. The ends of the branches died away, and the trees were very much smaller. No amount of care, attention, or watering, appeared to keep up the fertility of the trees.

Mr. STEPHENS: Is that not caused by the ground being badly drained?

Mr. SHOOBRIDGE said no. This occurred in some of the most porous soils he knew of. There was very little difference whether there was irrigation or not.

The CHAIRMAN said there were some trees 50 or 60 years old at Sandy Bay perfectly healthy and bearing good crops.

MOUNT BISCHOFF.

Mr. STEPHENS referred to a paper read last session, written by Baron Von Groddeck, Germany, entitled, "Remarks on the tin ore deposits at Mount Bischoff," translated by Mr. G. Thureau, F.G.S. Specimens of the rock described in the paper not having been sent with the paper, Mr. Stephens stated he had received from Mr. C. P. Sprent specimens of the rock heretofore described as quartz porphyry or eurite, which he had sent to Professor Liversidge, who had kindly given him the following notes:—"I am sorry to say that I have no time just now to make analyses of them nor even sections for the microscope, and without doing both of these it is often very difficult to identify rocks, and not always then. The white rock from Mount Bischoff, which looks like a quartz po phyry, is undoubtedly a topaz rock as described by Baron V. Groddeck; the sp. gr. is far too high for a felspathic rock, and it is as rough to the touch as a trachyte, moreover it contains flourine, which is readily detected before the blowpipe. This association of topaz and tin is a very interesting one. I think topaz crystals ought to be found in the cavities of the rock. If you can set anyone to collect in the district probably interesting discoveries would be made."

NOTES AND EXHIBITS.

Mr. C. J. Atkins exhibited specimens mounted for the microscope, a fresh-water algæ (*Anacharis alsinastrum*), commonly called in England the water thyme. It is said to have been introduced in England from North America, and has since spread with such rapidity through the canals and rivers as in many instances seriously to impede their navigation. The specimens before the meeting were obtained from the pond in Franklin-square, where it appears to have taken a firm hold.

VOTES OF THANKS.

On the motion of Mr. JUSTIN BROWNE, seconded by Col. LEGGE, a vote of thanks was awarded to the various donors and the gentlemen who had furnished papers.

The meeting then terminated.

JUNE, 1886.

The monthly evening meeting of the society was held on Tuesday, June 8th; Mr. James Barnard (vice president) in the chair.

The following gentlemen were elected corresponding members:—Mr. Chas. Gould, F.G.S.; Prof. Alexander Agassiz, Curator Museum of Comparative Zoology at Harvard College, Cambridge, Mass.; Prof. Geo. W. Tryon, jun.; Conservator of Conchological Museum, Philadelphia.

List of additions to the library during the month of May:—

Annals and Magazines of Natural History, April.

Annual report of the Trustees American Museum of Natural History for the year 1885-6.—From the Trustees.

Athenæum, March.

Circulars of information of the Bureau of Education No. 1, 1884. Meeting of the International Congress at Rome in Oct., 1884, Nov. 2, 1884. The teaching, practice, and literature of shorthand by Julius

Ensign Rockwell, No. 3, 1885. A review of the reports of the British Royal Commissioners on technical instructions, with notes, by the late Chas. O. Thompson. No. 4, 1885, Education in Japan. No. 5, 1884, suggestions respecting the Educational exhibit at the World's Industrial and Cotton Centennial Exposition. No. 7, 1884, aims and methods of the teaching of Physics by Prof. Chas. K. Wead. Building for the Children in the south. Report of the Director of the American School of Classical Studies at Athens for the year 1882-3.—From the Department, Washington.

Descript ve Notes on Papuan Plants, VIII., by Baron F. Von Mueller, K.C.M.G.—From the author.

Geological Magazine, April. Imperial Federation, Vol. I., No. 4, April—From the Editor.

Journal of the Society of Arts, Mar. 5, 12, 19, 22; Journal of the Bombay Natural History Society, No. 2, Vol. I., April, 1886—From the Society.

Mon hly Notices of the Royal Astronomical Society, Vol. XLVI., No. 5—From the Society.

Mythical Monsters (Illustrated), 1886, by Chas. Gould, F.G.S.—From the Author.

Nature, Vol. XXXIII., March.

Proceedings of the Yorkshire Geological and Polytechnic Society, new series, Vol. IX., pt. 1, pp. 1-44, plates—From the Society.

Report of the Commission of Education for the year 1883-4—From the Dept.

Romaji Zasshi, a short statement of the aim and method of the Romaji Kai (Roman Alphabet Association of Japan)—From the Romanization Society Tokio, Japan.

Verhandlungen der Gesellschaft Für Erdkunde Zu Berlin, Band XIII., No. 3—From the Society.

PAPERS.

A short paper, entitled "The Occultation of Jupiter, 16th April 1886," by Mr. A. Biggs, was read, in the absence of the author, by the Secretary, Mr. A. Morton.

A paper, entitled "Natural Geometry," illustrated by diagrams, by Mr. A. Mault, was read. The author stated that his paper was intended to make the study of mathematical reasoning, and through it all other reasoning, more easy of apprehension, using visible, concrete demonstrations, instead of abstract ones. The system he (Mr. Mault) proposed is especially adapted to technical teaching, and for the use of elementary schools. It will be reasoning by sight, and reasoning helped by sight.

Mr. KINGSMILL asked leave, as a teacher of mathematics, to be allowed to make some observations in reference to the subject. He had heard the paper read with great interest, because he thought it indicated the true method of teaching mathematics to the young. Locke said, in his essay upon "The Human Understanding," that "a clear idea was the first part of reasoning," and the great advantage of the system illustrated by Mr. Mault was that it put the clear idea before the minds of the pupils. It showed in a very interesting way how experiments might be made in the geome ry of areas, and the volumes of solids. He might say that he had tried the same system himself, and many teachers of mathematics in England and on the continent were doing the same. He had been at some disadvantage in not being able to get the newest books on the subject, but he had made up a number of examples with a view to teaching in this way. Two examples made use of by Mr. Mault he considered to be of the greatest value, namely, obtaining the area of

the circle by multiplying half the circumference by the radius, and finding the volume of a pyramid by multiplying the base by a third of the height. There were a great many branches of geometry which could be illustrated experimentally, though the geometry of angles was what he had chiefly taught by this means. He had set a class of boys, about 20 in number, to draw triangles with a ruler. Naturally the triangles would be of all sorts of shapes and sizes, but having taught them the use of the ("protractor," he set them to measure the three angles and tell the number of degrees of them all. One boy would get it 179deg., and another 181deg., but all would be very near 180deg They soon came to the conclusion that the three angles of all triangles contained 180deg., or two right angles, and this was impressed upon their minds before commencing upon Euclid's demonstrations. He also set the boys four sided figures, and told them to measure all the angles, and they always approached 360deg., or four right angles, and their minds were thus led to the conclusion that the angles contained in all quadrilateral figures amounted to four right angles. He did the same with regard to five sides figures and polygans. He found that the boys took the greatest possible interest in the study thus afforded them, many boys who had had to confess that they could not see the object of Euclid's demonstrations admitting that they began to see something in it after all. His belief was that if a class of boys were kept at that sort of work for six months they would learn more of Euclid's elements in the ensuing six months than they would otherwise do in 12 months. He had used this system in teaching elementary trigonometry, and the results of the work he set his boys were surprisingly correct He had got a small class through the elements of this branch of mathematics with the greatest satisfaction both to himself and the boys. There was no royal road to geometry, but the experimental method was an advance on the old one, and the nearest approach that could be found.

Mr. E C. Nowell expressed the great gratification he had received from hearing Mr. Mault's paper read, and hoped its effect would extend much further than the walls of the Royal Society's chamber. He hoped some practical steps would be taken by the council of the society to bring the subject under the notice of the State school teachers, and the Director of education, with a request that he would interest himself in introducing this system into the State schools. He was perfectly sure that the proper mode of teaching was to teach the concrete first and the abstract afterwards. An utterly wrong principle had been adopted in their educational system, as the abstract was first and the student left to find out the concrete himself. A great portion of the time supposed to be spent in education was just thrown away. There were very few people with brains so formed that they could grasp the abstract without the concrete. Although he had forgotten nearly all his geometry, it had taught him the best methods of reasoning, and showed him that one must be very careful of the groundwork. It was well known that things presented to the eye had a greater effect on the mind than those which were only presented to the imagination. He hoped, therefore, that this paper would have some practical effect, and that steps would be taken to bring it before the pointed attention of all those who were engaged in the State schools.

Mr. Bernard Shaw expressed his pleasure at having heard such an able paper read and thought Mr. Mault deserved their sincerest thanks.

On the suggestion of Mr. Morton it was decided that the paper should be published.

On the motion of Mr. KINGSMILL votes of thanks were accorded Messrs. Mault and Biggs for their papers.

The CHAIRMAN, in putting the resolution, regretted that Mr. Stephens, the Director of education, was not able to be present through pressure of work, but he had no doubt the paper, would receive full consideration in due course.

Mr. MAULT, in responding, said that he would spare no pains to forward the course of education in this respect. He understood that the Government had initiated some technical schools, under the direction of Mr. Charpentier, and he would be glad to present him with a set of models, which would illustrate the system he advocated in his paper.

The proceedings then terminated.

JULY, 1886.

The monthly meeting of the Royal Society was held on Tuesday evening, July 13. Mr. James Barnard in the chair.

The CHAIRMAN said he was sure they all deeply regretted the late sad railway accident that had taken place since the last meeting of the Society, one of the sufferers being their worthy hon. sec. (the Hon. J. W. Agnew); but he was pleased to learn that Dr. Agnew was in a fair way of recovery, and hoped that a few days would see him about again. (Applause.)

Messrs. W. Blanch Brain, F.S.S., G. S. Perrin (Conservator of Forests) were elected Fellows of the Society.

List of additions to the Library during the month of June :—

Agricultural Gazette.

Annals and magazines of Natural History, No. CI., May.

Appendix to the Statistics of New Zealand for the year 1884. A series of diagrams, showing the progress of the colony by increase of population, trade, live stock, cultivation, occupied holdings, etc.—From the Government.

Astronomical observations, 1882-5, Rousdon Observatory, Devon, made under the superintendence of C. E. Peck, M.A.—From the Society

Athenæum, April.

Australian Mosses, enumerated by Mr. W. Mitten.—From Baron F. Von Mueller.

Bollètino della Societâ Geograpfica Italiana, serie II., vol. XI., April, 1886, Anno XX., Fasc. 4.—From the Society.

Bulletin de la Societa Imperiale des Naturalists de Moscow, Année 1885, Nos. 3 et 4.—From the Society.

Catalogue des Portraits de Voyageurs et de Géographes qui se trou vent dans les Albums de la Societe de Géographie a la date du 22 Novembre, 1885.—From the Society.

Fac similes of four old Charts of Australia.—From the Trustees Public Library, Melbourne.

Geological Magazine, May, 1886.

Imperial Federation, No. 5, Vol. 1, May 1886.—From the Editor.

Indian Meteorological Memoirs, Vol. III., Pt. 1, 1. The Rainfall of India, Vol. IV., Pt. 1.—From the Department.

Insects of the Fly River, New Guinea—"Coleoptera," by Wm. Macleay, F.L.S., etc.—From the Author.

Journal of the Royal Microscopical Society, Series II., Vol. 6, Pt. 2, April, 1886.—From the Society.

Journal of the Society of Arts, April.

List of Members of the Geological Society of Australia; also a set of works in the Library of the Society.—From the Society.

Mémoires de la Sociètè Royala des Sciences de Liege, Deuxiéme Série, Tome XI.—From the Society.

Meteorologische Beobachtungen ausgeführt am Meteorologischen Observatorium der Landwirthschaftlichen Akademie.—From the Society.

Monthly notices of the Royal Astronomical Society. Vol. XLVI. No. 6. April, 1886.—From the Society.

Nature, April. Vol. XXXIII. 1886. Occasional papers on the Queensland Flora. By F. M. Bailey, F.L.S.—From the author.

On the Flexure of Meridian Instruments and the means available for eliminating its effects from star places. By Wm. Harkness.—From the author.

Proceedings of the Linnean Society of N.S. Wales, second series, Vol. I, Pt. 1.—From the Society.

Proceedings of the Canadian Institute, Toronto, third series. Vol. III. Fas. No. 3. February, 1886.—From the Society.

Records of the Geological Survey of India. Vol. XIX. Pt. 2. 1886.—From the Society.

Report of the second ordinary meeting of the Queensland branch of the Geographical Society of Australasia. March, 1886.—From the Society.

Report of the Technological Industrial and Sanitary Museum, Sydney, N.S.W. 1885.—From the Trustees.

Report on the progress and condition of the Botanic Gardens and Government plantations, Adelaide, during the year 1885.—From the Director.

Report of the Mining Register for the quarter ended 31st March, 1886, "The Goldfields of Victoria."—From the Department.

Statistics of the colony of New Zealand for the year 1885. Part III. Trade and Interchange.—From the Government.

Sociétié de Geographie, No. 7, 8 —From the Society.

Transactions of the Royal Historical Society. New series. Vol. III., Part II.—From the Society.

Transactions and Proceedings and Report of the Royal Society of South Australia. Vol. VIII. for 1884-5.—From the Society.

Victorian Naturalist. Vol. III., Nos. 1, 2, May and June, 1886. —From the Society.

PAPERS.

"Collection, Observation, and Identification of Mosses," by Mr. R.A. Bastow, F.L.S.—

The most favourable collecting grounds around the city of Hobart were mentioned, with the species most likely to be met with in those localities. The summit of Mount Wellington, the Ploughed Fields, the Springs, the Falls, St. Crispin's Well, Macrobie's Gully, Mount Rumney, and Kangaroo Point, were severally noticed. The manner of identification of the Genera by means of an illustrated key prepared by Mr. Bastow was made clear by an example. This key has been prepared specially as an introduction to the study of Tasmanian mosses, and is a new feature in the introductory portion of bryology. The Tasmanian mosses are the first in the botanical world to have been thus diagramatically arranged, so that the student may have all the genera before him on one sheet, so bracketed and arranged, that he can almost at once find out the genus of the specimen in hand. One species of each genus is represented, in its natural size, and as

it appears under the microscope with a 1½in. objective. The key also contains short generic description; these in conjunction with the list of Tasmanian genera, their authors, the English meanings of the generic names, and the habit of each genus, in the body of the paper, will afford assistance that has been long required in the pursuit of this branch of cryptogamic botany. Mr. Bastow must be congratulated on having completed a scheme which has cost him a great amount of labour, and which ought to be thoroughly appreciated by those for whose benefit it has been worked out. Several beautiful specimens of mosses, mounted in glycerine jelly, were exhibited under the microscope, and by the use of the spot lens, the natural colours of the plants were vividly brought out.

THE DISCOVERY OF AUSTRALIA BY THE PORTUGUESE.

In reference to the presentation of photo-lithographs of four early charts of Australia, Mr. J. R. McClymont made the following remarks:—

"The maps lying on the table are photo-lithographs, in part or whole, of four MS. maps of the sixteenth century, taken from the originals in the British Museum at the instance of the Trustees of the Melbourne, Sydney, and Adelaide Public Libraries.

"In order that you may fully understand their place and significance in the geographical history of Australia, it is necessary to revert to a period considerably anterior to that of their execution.

"From very early times there existed a belief in a southern continent, as Mr. Major shows by references to Manilius, Aratus and Strabo. Pomponius Mela, writing in the first century after Christ, inquires whether Taprobana, to the south of India, be an island or the commencement of a second world (*insula aut prima pars alterius orbis*) and Ptolemy (2nd century) places a *terra incognita* to the south of the Indian Ocean, connecting Asia with Africa, and forming that ocean into an inland sea. The myth may have arisen from the supposed necessity for a southern tract of land to counterbalance the continents of the northern hemisphere, supported in later times by the knowledge of the southward extension of Asia in the Malay Peninsula and adjacent island of Sumatra. The geography of Ptolemy was in general use until the voyages of the Spaniards and the Portuguese to the south gave a new form to the ancient conception of the southern hemisphere. But even after their discoveries, the Ptolemaic conception influenced the representation of the southern lands.

"About the year 1531 a new departure is made by the map-makers, some of whom now show the *Terra Australis* with a vast extension to the northward in a position roughly approximating to that of Australia as it is known to us. This appears, for example, on a woodcut map of the year 1531, by the French geographer, Oronce Finé, published in the *Nova Orbis* of Grynæus (Parisiis, 1532.) 'The globe of Orontius Finé, of Dauphiny,' writes Mr. Petherick, 'one of the best records of the geographical knowledge of that date, shows the Indian and Pacific Oceans, almost as one, with what might be intended for the north coast of Australia as low as the tropic of Capricorn and about half-way between Africa and South America.' *Mel. Rec. ix. 158.* These outlines have no resemblance to the real Australia. The map has the legend '*Terra Australis recenter inventa sed nondum plene cognita.*' There is also in a polyglot bible by Areas Montanus, vol. III, of the date 1571, and printed at Antwerp, a mappe-monde, showing a curved line indicating the north part of an unexplored land exactly in the position of the north of Australia, distinctly implying an imperfect discovery.' Major's *Prince Henry*, p. 295. In other engraved maps of that century, the coast line of the *Terra Australis*, beginning in *Tierra del Fuego*, trends westward in the same latitude until it reaches the longitude of

New Zealand, where it curves northward and westward till it attains a latitude more or less corresponding with that of the north of Australia. Sometimes New Guinea is connected with the *Terra Australis*; in other maps, they are separated. The coast-line finally recedes southward and westward to the same highla itude in which it originated.

"Two sources are clearly indicated whence this augmentation took their rise. First, we must look to the pages of Marco Polo, who tells us that by steering a course between south and south-west from Java for seven hundred miles, 'you fall in with two islands, the larger of which is named Sondur, and the other Kondur. Both being uninhabited, it is unnecessary to say more respecting them. Having run the distance of fifty (or five hundred) miles, from these islands, in a south easterly direction, you reach an extensive and rich province, that forms a part of the main land, and is named Locach, (*iii. 7.*) It has been shown that 'Java' was erroneously introduced into the text as the point of departure, it should have read 'Champa,'—the ancient name of a kingdom which embraced the coast from Tongking to Cambodia. Colonel Yule shows Locach to have been Lo-kok, the lower part of what is now Siam; Sondur and Condur were the Pulo Condore Islands. The cartographers of that age, however, implicitly following the text of Marco Polo, placed these names upon the northern part of the *terra australis*, and, in their striving after accurate detail, complicated the ancient error. The other source to which I allude, is, of course, the discovery of Magellan in 1520, as indeed appears from the inscription on one of the maps, that of Ortelius (1587); 'Hanc continentem australem nonulli Magellanicam regionem ab ejus inventore nuncupant.' Whether a third source of information may not have been drawn from is a question to which I shall revert further on.

"Although these engraved maps are less correct than certain MS. maps, the fac-similes of which lie before us, the latter are the earlier. They differ from the engraved maps chiefly in three points. First, that in one of them at least the Southern land is shown independently of any connection with the supposed Antarctic continent, or with Magellan's *Tierra del Fuego*; secondly, that the outlines are no longer vague curves but are definitely suggestive of actual observation; and thirdly, that the bays, capes, and islands bear significant names, and that in the Portuguese language or a Gallicised form of it.

"There are eight of these maps bearing the names of French cartographers although apparently copied from a Portuguese original, and they may be catalogued as follows:—

1. Map of the world on a plane projection. Anonymous. As it bears his arms, it was probably executed in the time of Francis, I., for his son the Dauphin, afterwards Henry, II. [1530 ?] In the British Museum.

2. Map of the world in hemispheres in a work, 'The Book of Idrography' dedicated to Henry VIII. by Jean Rotz, 1542. In the British Museum.

3. Map of a part of Asia from Cape Comorin to Aimoey in China. In the same volume.

4. Map in a hydrographic atlas bearing the name of Nicholas Vallard, Dieppe, and the date 1547. In the library of Sir Thomas Phillips, Bart., Middle Hill, England.

5. Mappemonde painted on parchment by order of Henry II., King of France.

6. Mappemonde made by Pierre Desceliers, of Arques, 1550. In the British Museum.

7. Map drawn by Guillaume le Testu in 1555. In a portolano at the Depôt de la Guerre in Paris.

8. Mappemonde by Nicholas Desliens, of Dieppe, 1566. In the Bibliothèque Nationale in Paris.

"All of these agree in the main in their representations of a vast country separated by a narrow strait from the Island of Java, and on which is inscribed the name 'The Londe of Java,' or 'Jave la Grande.'

"Mr. Major suggests three questions in connection with these maps of Java. First--Are their points of resemblance to the maps of Australia sufficiently striking to justify us in believing that the originals whence they were taken were based on actual discoveries? Secondly—If so, who were the discoverers? And, thirdly, at what date were the discoveries made?

"Had we only the map of Desceliers to guide us we would hardly be justified in saying that anything further was represented than the *Terra Australis* of the myths, for in that map we find the fictitious Southern Continent shown in very much the same way as in the engraved maps of which I have been speaking, and in it the western coast line of what might be supposed to denote Australia, is carried so far to the south as to suggest a merely hypothetical country. Turning, however, to the Dauphin map and that of Rotz in hemispheres, the matter assumes a different aspect. In the former it is true the coast lines of Jave la Grande are produced far south of the latitude of Australia, but they cease to be definite or suggestive of actual physical features on the west side at a latitude exactly corresponding with that of the south-western limit of Australia proper. In the map of Rotz they cease entirely in that latitude. The eastern coasts are much more perplexing. I will only say at present that the utmost recognisable limit towards the south is in 45°, or nearly the latitude of the south of Tasmania. Both coasts reach to about 10° S., in the northern direction.

"As might be expected, the longtitude is much less exact. Maury tells us, in his chapter on the *influence of the gulf stream upon climates and commerce*, that it was not unusual at the end of the last century for sailors crossing the Atlantic to be 6°, 8°, or 10° out of their reckoning in regard of longitude in as many days at sea. It can hardly then be matter of wonder if those navigators of the sixteenth century were as many degrees out as they had been *months* at sea. On the west side there is a deficiency of about 11°,—126° E. of the Cape Verde Islands instead of 137°. On the east side is an excess of about 9°,—187° E. of these islands instead of 178°. Adding the two errors we find that Jave la Grande is credited with 20° too many of longitudinal extent.

"It may be noted here that all this coast line cannot have resulted from one voyage. Hence the fact of an error of excess on one side of the map being supplemented by an error of the opposite character on the other side need excite no surprise. The maximum error is one of 11°, which, in regard to longitude, must be considered as trifling for that period.

"We have next to consider the contour of these coasts as compared with that of Australia. It should be remembered that, in all probability, the originals were mere flying sketches of what was seen of the coast from weather-beaten ships, and made no pretension to accurate survey It is very much as if two of us, never having seen a map of Tasmania and ignorant of its insular character, were to be cast, the one on its east, the other on its west coast; were, in passing along, to jot down its outlines as they appeared to us; and as if these sketches were to fall into the hands of some mapmaker on the other side of the world to be elaborated into a map, and placed in proper position relatively to the other countries of the globe. We may safely say that these outlines of Jave la Grande bear as great a resemblance to the Australian coasts as our hypothetical map of Tasmania would do to the

coasts of this island. As a matter of fact, the outlines in question resemble Australia quite as much as those of South America in some of these maps resemble the South America of our modern atlases. There is one wide divergence from approximate similiarity in the south-east corner of the maps—a divergence which, as I think, has not so far been adequately dealt with, and with which, as I hope to deal with it on a future occasion, I shall not occupy your time at present.

"Finally, mark the position of Jave la Grande relatively to the other known continents and islands, and you will observe that it holds the place of the true Australia. An exception is its relation to the Malay Archipelago, for it is placed immediately to the south of Java, Flores, and Timor. This arose partly from the errors in longitude already alluded to, partly from the tendency to unite all imperfectly discovered lands in the Southern Ocean into one southern continent,—a survival of the old Ptolemaic teaching.

"Assuming then as proved that these maps are based on actual discovery, we have next to enquire who were the discoverers. On this point we are fortunate in having independent testimony. On the same map of Mercator, of the date 1569, on which occur the misunderstood extracts from Marco Polo applied to one portion of the *Terra Australis*, such as 'Beach provincia aurifera,' 'Maletur regnum scatens aromatibus,' occurs also on another portion, to the south of Africa, this remarkable inscription—'Psitacorum regio sic a Lusitanis hûc libegio vento appulsis, cum Callicutum peterent appellata propter earum avium multitudinem. Porro cum hujus terræ littus ad 2000 miliarium prosequuti essent, necdum tamen finem invenerunt, inde australem continentem attigisse indubitatum est.' This inscription is supported by a similar one which occurs on a map of the antarctic hemisphere in the *Speculum Orbis* of C. de Judæis, Antwerp, 1592, on that part of the *Terra Australis* opposite the Cape of Good Hope—'Lusitani, bonae spei legentes capitis promontorium, hanc terram austrum versus extare viderunt, sed nondum imploravere.' The source whence this information was derived is that to which I alluded in saying that the engraved maps of the sixteenth century were not indebted exclusively to Marco Polo and Magellan for their delineation of the *Terra Australis*. We gather from these inscriptions that the Portuguese on their way to India by the Cape of Good Hope were driven by a W., or more accurately W.S.W., wind (Libs) on the western coast of Australia which they followed for 2000 miles. The region between the Cape and Australia is now ascertained to be a well marked region of cyclones, with a prevailing direction from W.N.W. 'Within 20 years,' writes Mr. Petherick, 'from the departure of Vasco da Gama (1497), thirty-three fleets, composed of 220 ships of war, had been sent out from Lisbon to the East.' *Athenaeum*, June 28, 1884. It would not be strange if some of these vessels fell in with westerly storms of such violence as to drive them into Australian waters.

"The map of Desliens is in one respect of paramount importance, for it places the flags of the various nations on the lands discovered by their seamen, and on Jave la Grande it places the flag of Portugal. It may well be asked whether this be not the one link wanting to connect these MS. maps with the chance discovery so briefly but circumstantially narrated by Mercator.

"Lastly, as to the date. This, in default of information, cannot be fixed with accuracy, but may fall between the years 1500,—the date of the Portuguese expedition toIndia following that of Vasco da Gama—and 1536, the latest probable date of the earliest of these maps.

"There is one other matter to which I will briefly allude before closing. A great deal has been said about the disappearance of the original drawings from which these maps of Jave la Grande were constructed, and

about the silence of Portuguese historiographers concerning the discovery, and these facts have generally been attributed to a desire on the part of the Portuguese to conceal their discovery from the Spaniards for fear of interference with their trade. A similar desire for concealment has been attributed on similar grounds to the Dutch, and has been sufficiently disproved. But there seems to have been no difficulty on the part of individuals who were really interested in the matter to obtain access to the original drawings, or to learn such details as were to be learnt regarding the discovery. Seven pilot-cartographers in France, Mercator, and others in Holland, taking a geographer's interest in a new discovery, found out, apparently, all they could know about it. The discovery was one of little interest to the Portuguese, whose only object was to discover fresh fields for their commerce, or to find better paths for their fleets. Australia was no field for commerce, the Australian route no route for their Indian fleets. Wytfliet, writing in 1598, says that after one voyage and another that route was deserted, and the country was seldom visited, except when sailors were driven thither by storms. As early as the days of Marco Polo, and at intervals ever since, the inhabitants have been characterised as cruel, and the shores as inhospitable, and no trade is said to have been practicable with the natives of that country. Hence the discovery was only regarded as important by map-makers, who probably threw aside the original charts as soon as they had incorporated them in their maps, or if these charts remained in Lisbon up to the time of the great earthquake, they may have then been destroyed, Their loss is not unique. What has become of the majority of the drawings from which the map of Tasman was constructed 100 years later? I do not say that a political motive may not have sealed the lips of the historiographers, although the reasons I have given as conducing to render unimportant the discovery of Jave la Grande would operate in their case also. In those days it was not uncommon for a ship to be blown upon an unknown and unlocated coast."

Mr. McClymont said that his remarks must not be regarded in the light of an original paper, as he had only followed in the lines laid down by Mr. Major in his painstaking work. He would be gratified if the acquisition of these maps, or anything he or any other member might say on the subject could awaken an interest in the subject of historical geography, which suffered from neglect. He had been surprised at the ignorance respecting Tasmanian discovery exhibited by all classes of the community. He thought the maps now acquired might very well form the nucleus of a Map Department in the Society's Library.

Mr. C. T. BELSTEAD, after alluding to the value of the key to the "Tasmanian Mosses," and the paper by Mr. Bastow, as also to the very interesting remarks by Mr. J. R. McClymont, proposed the usual vote of thanks, which was seconded by Lieut. BEDDOME, and supported by the CHAIRMAN. The proceedings then terminated.

AUGUST, 1886.

The monthly meeting of this society was held in the Society's rooms last evening, August 10, Mr. James Barnard, V.P., in the chair. Over 40 members were present and several visitors.

List of additions to the library during the month of July.

Annalen des K. K. Naturhistorischen Hofmuseums redigirt Von Dr. Franz Ritter Von Hauer, Band I., No. 2; Wien, 1882.—From the Society.

Annals and Magazines of Natural History, No. 102, Vol. 17; June, 1886.

Archives du Musée Teyler, Serie II., Troisièmere Partie.—From the Society.

Bollettino della Societa Geographica Italiana, Ser. II., Vol. XI., Maggio and Guigno, 1886, Anno XX., Fasc. 5, 6.—From the Society.

Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XII., No. 3. Observations on the development of Agelena raevia, by W. A. Locq, with 12 plates.—From Alexander Agassiz.

Catalogue de la Bibliothèque dressé par C. E. Ekama. Premier livraison, Encyclopedies, publications, academiques, et recuers periodiques.

Ditto, ditto, deuxieme, livraison, anatamoic physiologic, development, Hist. Nat. Universelle Hist. Nat. de différents pays; Anthropologique Ethnologie.—From the Society.

Catalogue of the fossil mammalia in the British Museum, part 3 containing the order Ungulata, suborders, Perissodactyla, Toxodontia, Condylarthra, and Amblypoda.—By Richard Lydekker, B.A.

Ditto, of the Passeriformes, or perching birds in the collection of the British Museum. Fringilliformes, part 3, containing the Families Cœrebidæ, Tanagridæ, and Icteridæ, by R. L. Sclater:—From the Trustees.

Geological Magazine, June, 1886.

Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum, part 6, by A. G. Butler. Introduction to the Study of Meteorites, with a list of the Meteorites represented in the collection (British Museum).—From the Trustees.

Journals and Papers of Parliament (Tasmania), Vols. 4, 5, 6, 1885.—From the Government.

Journal of the Society of Arts, May.

Monthly notices of the Royal Astronomical Society, Vol. XLVI., No. 7; May, 1886.—From the Society.

Nature. May.

Observations and researches made at the Hong Kong Observatory in the year 1835, by W. Doberck.—From the Government.

President's address of the Royal Society of New South Wales, 1886, by Professor Liversidge.—From the author.

Summary report of the operations of the Geological and Natural History Survey to 31st December, 1885, being Part III. Annual report of the Department of the Interior, 1885. Geological and Natural History Survey of Canada.—From the Society.

Scientific Transactions of the Royal Dublin Society, Vol. III. (Series II.). VII.—Notes on the aspect of the planet Mars in 1884, accompanied by sketches made at Observatory, Birr Castle, by Otto Boeddicker, Ph. D., Plate VI. VIII.—On the Geological age of the North Atlantic Ocean, by Edw. Hall, L.L.D., Plates VII. VIII. XI.—On the changes of the radiation of heat from the moon during the total eclipse of 1884, Oct. 4, as measured at the Observatory, Birr. Castle, by Otto Boeddicker, Ph. D., Plates IX. X. X.—On the collection of the fossil Mammalia of Ireland in the Science and Art Museum, Dublin, by V. Ball, M.A., Plate XI., March, April, October, November, 1885.—From the Society.

Scientific Proceedings of the Royal Dublin Society, Vol. IV., N.S., Plates VII, VIII, IX, April, July, and October, 1885, Vol. X., N.S., Plates I, 2, January, April.—From the Society.

Sixteenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the session 1885-6.—From the Society.

Société de Geographic, Nos. 9, 10, 11, 1886.—From the Société.

Statistical Register of the Colony of Victoria for the year 1885, Pt. 1, Blue Book.—From the Government Statist.

Verhandlungen der Gesellschaft Für Erdkunde zu Berlin, Band XIII., No. 5.—From the Society.

Victorian Naturalist, Vol. III., No. 3, July 3.—From the Society.

PAPERS.

1. On the Australian Pectens confounded with the New Zealand. P. laticostatus, Gray. By Professor Ralph Tate, F.G.S., F.L S. In his paper Professor Tate states that though not indifferent to the opinions of certain conchologists, yet in this particular instance he considers their identifications incorrect, and surmises that they have been made without comparison of authentic specimens. Accompanying the paper is a table of dimensions of convex or right valve of Pectens, *laticostatus exoptandus*, *albus*, and *fumatus*.

Lieut. Beddome stated, in reference to the Tasmanian Pecten, that Mr. Brazier of Sydney had last year given the name *Pecten Meridonalis*, to our *Pecten*, and therefore he (Mr. Beddome) was under the impression that Mr. Brazier's name would take precedence of Professor Tate's *P. exoptandus*.

2. A paper entitled "Is Jupiter Self-luminous?" by Mr. A. B. Biggs, was in the absence of the author, read by the assistant secretary. The subject was one that the author had been paying particular attention to of late. In the opening part, Mr. Biggs stated that it was with some diffidence that he submitted the paper, partly because he was doubtful of its being a subject of general interest. Perhaps, however, the fact that the question which the author had set himself to solve is intimately connected with that of the physical condition of Jupiter, and inferentially also of all the giant planets may lend an additional interest to the subject.

3. Mr. R. M. JOHNSTON read the following paper entitled :—"Note on the Discovery of Plant Remains in the Tertiary Marine Beds at Table Cape, Tasmania. "In making excavations at Table Cape for the new breakwater, Mr. Bell, the local engineer, at my request, very kindly made up a collection of the fossils which he met with, and forwarded them to me. In this collection I found a number of very interesting leaf impressions, associated with *Turritella Warburtonii*, Woods, and other well-known marine forms obtained from the calcareous sandstones, described by me in the proceedings of the Royal Society of Tasmania for 1876 as "The Turritella Zone." In one of the leaf specimens I recognised the well-known form *Sapotacites oligoneuris*, Ettingshausen, which occurs in the leaf beds of the Derwent, notably at Pipe Clay Bluff and One Tree Point. The importance of this discovery is very great, as it now enables us to determine more accurately the relationship of the *Palæogene* (infra-basaltic) leaf beds of Tasmania with the Tertiary marine beds in South Australia, Victoria, Tasmania, and New Zealand. The *Turritella zone* at Table Cape from whence the leaf impression were obtained forms the uppermost series of beds of the formation at that place. It is characterised chiefly by the prevalence of the shell *T. Warburtonii*, Woods, and *Panopæa Agnewi*, Woods, although the common forms of the lower beds are also found in abundance. In all, I recognised 12 distinct species of leaves, somewhat resembling forms occurring in the leaf-beds of the Derwent and Tamar basins. One of the impressions is undoubtedly a species of *Pteris* which I propose to name P. Belli, in honour of Mr. Bell, who has added several novelties to the list of Tasmanian fossils.

In addition to the specimens of leaf impressions, Mr. Bell also collected a fine series of marine fossils, including corals and molluscs.

The most of these have already been described, but there are two forms new to Tasmania of great interest.

The first is a fine specimen of the well-known Cephalopod, *Aturia zic-zac* J. Sowerby, hitherto only found in Australia and New Zealand. The second is undoubtedly *Pecten lucens*, Tate, a species only recently described by Prof. Tate, from Aldinga, and the Murray Cliffs, S. Australia.

With respect to the occurrence of the plant remains among marine forms, it is most probable that the calcareous sandstones were formed at the mouth of an estuary or river, and that the leaves and other land organisms were washed down and included with the marine forms. This interpretation also throws some light upon the discovery of the almost complete skeleton of the species of *Halmaturus* already obtained from this same calcareous sandstone. The specimen referred to is still in the Tasmanian Museum.

In conclusion, Mr. JOHNSTON said he hoped that Mr. Bell would continue to make observations in this interesting locality.

In submitting a new catalogue of Tasmanian tertiary fossils, Mr. JOHNSTON stated that it was now about eight years since a comprehensive catalogue of the tertiary fossils of Tasmania had been given to the world, and since then a great deal of work had been done, and very great additions had been made to the list then given. It was very desirable, in order that workers might ascertain what had been done, that a comprehensive and specific list should be given directing where distinct information might be gained. Accordingly he had prepared a descriptive list embracing what was known of the tertiary fossils, including some 380 species, and presented it to the Society in the hope that it would be found of service. He also presented the Museum with a number of rock types from which the interesting plant fossils had been obtained at Table Cape, and a fossil nautilus shell from the same locality, which was frequently found in Victoria, but had not previously been recorded in Tasmania.

4. Mr. A. MAULT read a long and able paper upon the "Drainage and Sewerage of Hobart," in which he contrasted the relative merits of surface drainage with underground drainage. He found that to complete the system of surface drainage and make provision for effectively carrying it out would cost a further outlay of £20,000, and the annual cost of keeping it in order would be—after providing £9,000 annually for emptying pails and interest on £20,000—£16,300. Against this, a system of underground sewers to receive water closets, and carry the drainage system right out into the tideway of the estuary, could be constructed for £60,000, and the annual expense, including interest on that outlay, would be only £7,000. Under the latter system, provision could be made for mechanical or chemical purification of the sewerage before it reached the outlets; and it could be discharged at half ebb tide so as to ensure its being carried out clear of Sullivan's Cove and Sandy Bay, though this would only be necessary in the case of the Battery Point sewer. Hobart was peculiarly favoured for such a disposition of its sewerage as fifteen million tons of fresh water flowed down the Derwent daily, and the $1\frac{2}{3}$ tons of solid fæcal matter that would be carried away in the sewerage by the institution of a general system of water closets would not be appreciable in this immense body of continually moving water. The whole question was the disposition of the liquid excreta and house-slops, as the addition of the solids was nothing in comparison with this. In Liverpool, with a population 26 times that of Hobart, and where the area of land drained by the Mersey was much smaller than the Derwent, notwithstanding these adverse circumstances, the system he advocated was found to work well, and though the rate of mortality was high there it was a densely packed town,

and statistics showed that it had greatly improved in the rate of mortality. In reply to the objection that sewerage should be applied to the land, he pointed out that the expense of doing so at Hobart would prevent its being done. And, in conclusion, quoted the opinion of Sir J. B. Lawes, that when sewage was turned into an estuary a harvest was reaped from it out of the sea, that was more valuable than could possibly be obtained from the land.

Mr. W. H. CHARPENTIER said it would be almost presumption on his part to offer any remarks on the subject after such an able paper, but he thought it was well-known he was not in favour of the underground system of drainage. The difficulty, to his mind, was whether, when it was got into the river, could they be sure it would be got away from Hobart. Anyone walking towards Long Point would find refuse, rubbish, and even excreta from ships in the harbour and from the rivulet thrown up on the beach there. These was also—he supposed he ought not to say so—gas tar or something resembling it. There was a line of tide running directly on to the beach at the point, and the difficulty would be to get the drainage past that point. A gentleman like Mr. Mault, if he had time and money enough, could take the sewerage up Mount Wellington and then out to the ocean; but the estimate given for the probable cost of taking the underground sewers into the estuary could only be guess work, and would probably cost a great deal more. Without trained workmen were obtained explosions and great additional expenditure might be looked for. In England they had men skilled in the construction of drains to supervise such works at every point, but here we would have to manufacture the men first. He next alluded to the dry earth system as carried out at Manchester, where a profit of £16,000 was made out of the municipal works carried on in connection during the last year he was acquainted with its operations. It was a fact that typhoid fever was always found wherever the water closet system was adopted. Manchester had a million of inhabitants, and the works for turning the earth closet matter into a marketable manure, for which the farmers were willing to give £3 16s. a ton, occupied 16 acres. If Manchester could make a profit of £16,000 out of these very expensive works we might learn a lesson from her, or, at all events, make some enquiry into the manner in which the Dolly Varden system was worked. In his opinion modern science was able to cope with the difficulty, and there was no necessity to take such a retrograde step as go back to the Roman system of a vast cloaca. He urged that the surface drains would be perfectly inoffensive here if the roads were properly made, and the corporation labourers worked with energy instead of following their brooms like a blind man does his dog, and spending the greater portion of the day talking.

Dr. PERKINS said he came to the discussion to listen to what others might have to say, as his views were pretty well known, and he was more desirous of hearing such views as were held by the last speaker and others who had thought over the matter. He was prepared to receive suggestions, and to adopt any plan which could be shown to be better than the one proposed. Personally he thought Mr. Mault had touched the point of the question when he said it resolved itself into the disposition of the liquids and house slops. At Manchester these had been discharged into the Irwell, and proceedings were being taken against the corporation for polluting the river. The water-closet system was also used at Manchester, and to show what the mayor and aldermen thought of it, it was used at the Town Hall in preference to the Dolly Varden system. The latter system made no provision for disposing of the liquids, and consequently the river was polluted. It was not returning to any antiquated practice in a bad

sense, and he believed the great Roman Cloaca was not built for a sewer, but to drain the Pontine Marshes and other low ground. But if water-carriage was the best system it was none the worse for being antiquated. In Torquay and Brighton,in England, and at Porto Bello, near Edinburgh, the whole sewerage was poured directly into the sea. What they had to discover was whether Mr. Mault was on the right track—whether he was advocating the right system—and not the details. He believed Mr. Mault had not taken the outlets sufficiently far out into the stream, and in their further extension, but there would not be any difficulty in discovering that point. At Adelaide, £350,000 had been spent upon underground drains, and Adelaide was now the best drained city in Australia, where outbreaks of typhoid similar to those in Melbourne were never known. It was true that Adelaide had secured her boon at a great expense, but it was a much larger city than Hobart, and was not nearly so favourably situated in physical facilities. Correct tracings of the currents in the Derwent could be obtained to guide the designs of such a work, but he could not say that he had witnessed what was described as the present state of the beach at Sandy Bay. The chief thing to consider was the physical characteristics of a locality. The Hobart sewerage could not be discharged on the land in the vicinity except at a very great cost, and Manchester could not discharge hers into the sea. Sir R. Rawlinson and other authorities had declared that it was better in some cases to pour the sewerage into the sea than on to the land. This was done at Liverpool, and the circumstances of Hobart were more like those of Liverpool than Manchester.

Dr. Hardy, who was heard by special leave as he was not a Fellow, said it was a question upon which men were divided, and each side, like politicians, was little likely to see any virtue on the other side. Personally he was not biassed, but prepared to alter his opinion, which was at present in favour of the system advocated by Mr. Mault, if good reasons could be given to him. He felt very strongly that all existing cesspits should be abolished. Adelaide was growing more healthy every year since the deep drains had been laid, but previously it was such an unhealthy city that he had refused a practice there. Manchester was an unfortunate place, for, having nothing but a small river, she was forced to seek for some system to meet her circumstances ; but London was a marvellously healthy city with a relatively smaller water supply than Hobart, and yet carries her drains into the river. People talked of the pollution of our noble river. As it did not pollute the Thames and the Mersey to any dangerous extent, it certainly could not affect the Derwent. He knew the drains in some parts of Hobart were at present very bad, and people who had come here to reside had left in consequence. He had made it a personal practise to avoid certain streets on account of the drains. The pan system had not remedied this in Melbourne, and had not proved a success there.

Dr. Bingham Crowther said he had a great deal more sympathy with the dry earth system ; it was importing a large amount of manure into the colony to fertilise our impoverished lands, and if we could dry our sewerage, and by chemical action make such a manure of it that the farmers would take it, we would be adding to the wealth of the colony. Underground drainage would cost an immense amount of money, which the people were barely prepared to pay at the present time. He attributed the typhoid fever at Launceston more to the cemeteries existing in the town, and the wretched cesspit system, more than the drainage.

Mr. Saville-Kent stated that at present the sewerage flowing into the river did not affect the fish detrimentally, though the tar

referred to did, and frequently killed the fish in the fishing boat wells, besides rendering others unfit for food. He was not prepared to say what the effect would be if the whole sewerage was discharged into the river. He thought Mr. Charpentier had exaggerated the condition of Sandy Bay beach, for fish ponds situated near there for rearing delicate fish were not affected.

Mr. WARD thought some provision should be made for settling or precipitating tanks as, owing to a peculiar law, matter held in suspension in fresh water settled rapidly on coming into contact with salt water. In view of this the drains should only be discharged at ebb tide.

Mr. C. H. GRANT said the paper was a valuable one, and the discussion which had followed was also a most valuable one, and for these reasons he would move the adjournment of the debate till next meeting, in order that the society might have the benefit of the views of some gentlemen not present. While doing so, he had a word of warning to give to those who advocated the underground system. He had practical experience of the system in London, and elsewhere, and would warn them that the expense always exceeded the estimate. No doubt the facilities here were better than in Adelaide, but there they had spent £350,000. It would be found that in Hobart there would be heavy rock cuttings to materially increase the expense. Then there was the private expenditure for branch drains and closets. In his opinion a satisfactory trap for water-closets had yet to be found, and he would advise them to consider well the question of the cost of deep drains before adopting them.

Mr. JUSTIN MCCARTHY BROWNE said he had been a great advocate of the dry system for many years, but he was disposed to pay the greatest attention to the conclusions a gentleman like Mr. Mault, armed with the latest scientific opinions, arrived at. The difficulty of all dry earth closets was that they made no provision for the disposition of fluids.

THE DRAINAGE OF HOBART.

By A. MAULT,
Engineer Inspector to the Board of Health.

Having lately had to report officially upon the sewerage of the City of Hobart, it has struck me that it might be useful to place before the Royal Society some facts and considerations connected with the subject. It is so important that the more it is discussed the better, provided that the discussion leads to the adoption, and the early adoption, of the best means to ameliorate the present condition of things.

To place the matter before you, allow me to make the following recapitulation from my official report to the Central Board of Health:—The area of the city is 1,270 acres; the population is about 25,000; the number of houses is about 4,500; the water supply is said to be equal to 65gal. a day to each inhabitant, or 330gal. to each house. There are probably 400 houses with water-closets, 600 with privies with moveable pails that are periodically emptied by the nightmen in the service of the corporation, and the remaining 3,500 have ordinary privies, the cesspools of which are emptied at much longer intervals of time. The length of public sewers is not accurately known, but the greater part of the city is without underground drainage. The length of streets is about 37 miles. The refuse of the city is at present dealt with as follows:—The more solid portion of the fæcal matter is disposed of in the water-closets and privies above-mentioned; the liquid portion of the

fæcal matter, together with chamber, kitchen, and other slops, is sent into the sewers, where there are any; where there are none, and where there are available street gutters, it is sent along them to the nearest watercourse or sewer, and these gutters are periodically swept out; where there are neither sewers nor available gutters this sewage is thrown upon the ground to find its way as it best can to some natural outlet. The house sweepings,, ashes, and dry refuse of a small part of the city are removed by the scavengering department, but in the greater part of Hobart the occupiers have to make their own arrangements for disposing of them, and the usual arrangement made in the smaller class of houses is to throw them into the streets or lanes, or leave them in the back yards. I do not intend in this paper to allude any further to the subject of the removal of dry refuse, as the sewage question by itself is quite important enough to occupy our attention to-night.

It will be remarked that, as nearly all the sewers and gutters run into the various watercourses flowing through the city, the watercourses themselves virtually become common sewers, taking into the Derwent part of the solid and the whole of the liquid fæcal matter and house slops. We all know the resulting condition of things. To remedy it, my report recommends that all house sewage be kept out of the gutters and watercourses, and taken by underground sewers discharging into the tideway of the estuary at points where, by using proper precautions, it will not find its way into Sullivan's Cove, or Sandy Bay. No plan of sewage treatment is at present proposed, but the outfall sewers are so arranged as to admit of the construction of depositing tanks and other works, should such at any time hereafter be found desirable.

Various problems had to be solved before any complete system could be properly formulated. In the solutions herein proposed it will be found that the greatest efficiency is invariably accompanied by the greatest economy.

Thus, take the question of the getting rid of house slops, and ask—which is the better plan, to convey them away by surface gutters, or by underground drains? To answer this, some general and some local conditions have to be taken into account. Surface gutters can only run a certain distance along the streets, and then, if there be no watercourse, their sewage must be taken to one by means of a sewer of some description. As it is impossible to prevent the admixture of chamber slops with those of the kitchen and wash-house, house slops rapidly become offensive when exposed to sun and air, so the gutters must be well made and frequently and thoroughly cleansed. These are conditions absolutely indispensable to the efficiency of any system of surface drainage. But this system cannot be applied to the whole of the city, the conformation of the ground, as will presently be described, preventing it. However, to apply it to those parts where it is practicable, it would be necessary to provide proper gutters to all streets that have none, and to improve the faulty pebble-paved gutters of many other streets, and connect all with the watercourses. These works would cost at least £12,000. Moreover, as above mentioned, the conformation of the ground in very many parts prevents the houses from being drained into the gutters in front of them, as on sideling streets the kitchens and offices are often a story lower than the front entrances. In such cases the drainage must be taken away, in a surface system, by proper open gutters at the back, and if the sewage from them in order to get to a watercourse, has to be taken through other properties, underground drains would have to be constructed through these other properties. The cost of these works would be at least £8,000, making the total cost

of what may be called surface drainage work £20,000. Furthermore, these open gutters would have to be cleansed at least once a day, and in some places that frequency would not be enough to prevent nuisance. The cost of this work, as at present done, is £4 a mile of street—a cost greatly in excess of what it ought to be. But, suppose by contract or otherwise seven-eighths of this could be saved and the work done at 10s. a mile, the yearly cost of a daily cleansing would be £5,500. The cost of water is not included in this—it will be considered further on. We thus get the yearly charge for removing house slops from the city by means of open gutters.

Interest on cost of works as above £20,000, at 4 per cent.	£800
Repairs and maintenance of above, at 5 per cent. ...	1,000
Cleansing (exclusive of water)	5,500
Total yearly cost (exclusive of water)	£7,300

The work done at this cost would not only be in direct contravention of the law as enacted by the 180th and 211st clauses of the Police Act of 1865, but would in other respects be by no means satisfactory. In hot weather the gutters would become offensive, in spite of a daily cleansing, and the various rivulets passing through the city would remain what they are—noisome open sewers, constantly needing cleansing, and very costly to cleanse.

On the other hand, a system of underground sewers capable of removing the sewage not only from the present number of houses in the city, but from double the number, could be constructed for about £60,000, for Hobart is so exceptionally favourably situated for drainage that in none of the streets would deep drainage be necessary. By this means the slops could be removed at the following yearly cost :—

Interest on cost of works as above £60,000, at 4 per cent.	£2,400
Repairs and maintenance, at 5 per cent.	3,000
Total yearly cost	£5,400

being £1,900 a year less than by open gutters, even if open gutters could be cleansed at an eighth part of the present cost of cleansing them, and this saving of £1,900 a year would be sufficient to pay off the capital cost of £60,000 in 22 years. So on the score of both efficiency and economy, the underground system of drainage is greatly to be preferred for the removal of household slops of all kinds.

It must not be forgotten that this question of open gutters against underground sewers does not affect the altogether distinct question of the ultimate disposal of the sewage. Both the gutters and the sewers convey the sewage to the Derwent, but the gutters in taking it there expose it all the way to our sight and smell, and give it every chance by exposure to sun and air to appeal to those senses in the most pronounced and offensive manner possible. Whereas in underground drains it is conveyed in the condition and under the circumstances least likely to cause offence. If the problem to be solved were the rapid and complete fermentation and putrefaction of sewage, no better arrangements could be made for solving it than those offered by bad gutters and unmade streets. If the problem were, as it really is, the safest and in every way the most inoffensive way of getting rid of sewage, the true solution is by properly constructed underground drains. There are, moreover, here two other important points in favour of the proposed sewers. They are these—first—that whereas the existing open drains deliver their sewage into the harbour, the proposed sewers would deliver it into the tideway beyond ;

and secondly, that whereas the existing open drains offer no facilities for sewage purification, if necessary, the proposed sewers do.

It may be thought by some that it is needless to dwell so long upon the subject of the disposal of house slops—that everyone, or nearly everyone, is agreed that underground drains are the best for carrying off this part of house sewage—that the real difficulty is in connection with the removal of the rest of the fæcal matter. People who think thus have not paid very much attention to the matter, for the settlement of the question as to the disposal of house slops is virtually the settlement of the whole sewage question. The addition of water-closet sewage to the rest of the sewage of a town makes so little difference to its character and composition as to practically make no difference to the effect produced by its discharge into a river. In other words, the Derwent would be just as much polluted by the sewage if Hobart houses were fitted with earth closets as if they were fitted with water-closets. For many illustrations of the truth of this I must refer you to my report, as well as for the testimony thereupon of the Rivers Pollution Commissioners at home, and all the leading sanitary authorities. In the last edition of Baldwin Latham's *Sanitary Engineering* there is a table given of the result of the examination of the sewage of a large number of towns with and without water-closets, from which it appears that on an average the sewage of towns without water-closets contains in every 100,000 parts 121·51 parts of solid matter either in solution or suspension, of which 31·932 parts are organic matter and 11·54 chlorine; and that of towns with water-closets contains in the same quantity 116·89 parts of solid matter, of which 35·934 are organic and 10·66 chlorine. However paradoxical it may appear that the addition of water-closet sewage to the other does not more affect its character, it is none the less a fact. And the fact admits of explanation. In water-closet towns it is more usual to keep street drainage out of sewers, as it is proposed to do in Hobart. This street drainage no doubt accounts for the excess of solid matter and of chlorine that the above quantities show to exist in the sewage of non water-closet towns as compared with that of water-closet towns. But for polluting power there is, as above stated, practically no difference between them. And thus, in the consideration of the relative advantages of dry closets and water-closets, the question of river pollution may be said to be eliminated.

As to the relative advantages of dry closets in any town where there is a proper water supply and drainage system—there are none. As to the relative disadvantages, they are many, and are pretty fully set forth in my report. To summarise them it may be remarked that all pail systems deal with only a small part of the fæcal matter of a population; that they are more disagreeable to use than water-closets; that the operation of emptying and cleansing them is always more or less offensive; that in times of epidemics they may spread infection or cause panic; that they are all far more costly than the water system, and that in places where their efficiency is most needed they depend for their efficiency upon the care of the most careless class of people.

This last disadvantage is usually brought forward as a reason for discountenancing the use of water-closets in the poorer districts of a town, but the remedy has been amply provided in the shape of trough closets and other contrivances. All the other objections raised on sanitary grounds against water-closets and their connection with drains are really objections against bad workmanship and bad arrangement, and not against properly constructed closets. Closets may be constructed so that it shall be impossible for sewer-gas to escape from them, so that it shall be impracticable to waste water by them or to stop the drain communicating with them. Consequently house

drainage, carried out on the lines laid down by the model by-laws of the Local Government Board at Home, and by the regulations of the Adelaide Board of Health, is certainly the healthiest and most satisfactory system for the disposal of all liquid refuse.

On other than sanitary grounds, objections are also raised against the adoption of water-closets, the principal being the quantity of water required, and the cost of the system. As to the quantity of water required—with proper arrangements less water is needed to flush closets than to flush gutters. If all the houses of the city were fitted with water-closets, with waste preventing cisterns, the quantity of water required daily for flushing them would be 20 gallons a day out of the 330 gallons furnished. The total quantity for the whole city would consequently be 90,000gal. a-day. On the other hand, if the whole city were drained by surface gutters, the cleansing of them, as before described, would require at least five gangs of scavengers. If these gangs worked eight hours a-day they would have fire plugs open for gutter flushing at least five hours of the eight. Of course the pressure on the mains varies in various parts of the city, but if we take a mean pressure of 150ft. and a mean length of 500ft. of 2in. pipe to each plug, these five plugs would deliver 180,000gal. during the five hours; so that, supposing that on one-fourth of the days of the year rain would supply sufficient water for flushing without opening plugs, street gutter flushing would require 45,000gal. a day more than closet flushing. In addition to this, gutter flushing on private properties would require a good deal of water, quite as much as sewer flushing, so that the whole of the above 45,000gals. a day would be saved.

As to the question of cost, there can be no doubt but that the cheapest plan for conveying fæcal matter from houses is by water carriage. If the plan for removing pails now partially adopted by the city be extended to all the houses, it is shown by my report that the cost will be £9,000 a-year. It may be thought probable by some that this amount might be reduced by profits on manufacturing manure from the collected matter, but this is so problematical that no independent engineer would counsel the corporation to expend money on the erection of works and machinery for such a business. Some manure companies might offer to take the matter as a gift—but they would have to be so carefully restricted in their manipulation of it, so as not to cause a nuisance, that they could not be expected to contribute towards the expenses of collection. The following considerations will show this :—The real value of a manure is practically dependent upon its dosages of nitrogen, and of soluble phosphoric acid, and at home all artificial manures and natural guanos are sold upon guaranteed dosages of these two fertilising elements. In the home market the value of these was usually about 1s. a pound for nitrogen, and 4d. a pound for soluble phosphoric acid. Thus a guano containing 6 per cent. of nitrogen and 15 per cent. of soluble phosphoric acid would be worth about £12 6s. a ton, as it would contain about 134lb. of nitrogen and 336lb. of phosphoric acid, and all the other ingredients in the guano would be simply regarded as forming the vehicle for conveying these two fertilisers to the land. Reckoned in this fashion, and it is the only true commercial fashion,—what would be the value of the manure that could be made of the collected matter here? In my report there is a reference to the method of collection at Rochdale, where the most perfect of these pail systems is at work. The matter collected is manufactured in the most scientific manner, so as to retain all that is practicable of its ammonia and phosphorus, and it appears from an account of a visit paid to the works in 1883, by the Association of Municipal and Sanitary Engineers, that the quantity so retained in the resulting manure is equal to a dosage

of ·516 of nitrogen, and of ·14 of soluble phosphoric acid in the collected matter—that is, 200 tons were treated to get one ton of nitrogen, and 700 tons to get one ton of soluble phosphoric acid. It seems to have been impracticable to get at the real cost of the process, but, seeing that it took more than two hours for the first treatment of every ton of the collected matter, the nitrogen obtained must have cost at least a quarter of its market price, and the phosphoric acid about double its price. Now, if in Hobart there were collected a quantity of matter, proportional in regard to population to that collected in Rochdale, that quantity would be about 2,600 tons a year, and the quantity of nitrogen obtainable from it would be 13·416 tons, and of soluble phosphoric acid 3·64 tons. These quantities show that the only legitimate profit to be made out of the treatment of the Hobart collection could not exceed a few hundred pounds a year, a sum that would be absorbed in interest on capital. And so no company could afford to pay anything to the corporation in diminution of the cost of collection. On the other hand, the cost, under a water-closet system, is limited to the supervision of that class of houses where ordinary closets cannot be entrusted to the occupants. In Hobart this supervision should not cost £1,000 a year. In the report it is estimated at £1,600, as the whole of the calculations therein are largely liberal, so as to be on the safe side.

The following is a summary of the total cost of removing all the sewage by the two systems :—

OPEN DRAINAGE.

Interest on £20,000, cost of necessary works, at 4 per cent.	£800
Repairs on above at 5 per cent.	1,000
Cost of gutter sweeping, exclusive of water	5,500
Cost of pail collection and cleansing	9,000
Total	£16,300

UNDERGROUND DRAINAGE.

Interest on £60,000, cost of necessary works, at 4 per cent.	£2,400
Repairs on above at 5 per cent.	3,000
Cost of emptying trough closets	1,600
Total	£7,000
Yearly saving of underground system	£9,300

You will observe that it is above taken for granted that the sewers provided for removing house slops are taken as being also sufficient for removing water-closet sewage. This is so. As Mr. Baldwin Latham says in the work already quoted :—"To what has already been stated it is only necessary to add that the introduction of the water-closet, with perfect water-waste preventing fittings, will not materially increase the volume of sewage for which provision will require to be made, as the water used for this purpose forms but a small part of the whole of the water used for domestic and general purposes; therefore, in districts in which ashpits, earth-closets, or other devices of this character are used for collecting fæcal matter, it will be well that the same provision should be made in the size of the sewers as is made in those districts in which water-closets are universally adopted."

The question of the disposal of the sewage remains to be considered. There is no doubt that where practicable it is desirable that sewage water should be purified before it be allowed to flow into a water-course. Up to the present the most satisfactory method of purification has been by surface filtration or irrigation. To carry this out properly,

about one acre of suitable land—strong land is the best—is required for each 100 of the population. The most successful sewage farm in England is that at Beddington, where the sewage of 66,000 inhabitants of the Croydon district is received on 600 acres of land without any pumping being required. The yearly value of the land on this farm has risen from £1 to £9 an acre. In my report it is calculated that if 200 acres of suitable land could be found, say near the old racecourse at New Town, or anywhere within three miles of Hobart, the cost of the land, of the drainage, levelling, etc., would be £30,000, the yearly interest upon which sum, together with maintenance, pumping, etc., would amount to £2,800 a year, so that there would be an annual first charge upon the land of £14 an acre, independently of cost of cultivation, etc. If a sewage farm in the immediate neighbourhood of the London market commands £9 an acre, who would give £14 an acre for one here? Consequently it may be said that irrigation as a means of disposing of Hobart sewage is out of the question.

As before mentioned the arrangement of the outfall sewer proposed is such that there is ample opportunity to apply to the sewage any mechanical or chemical system of purification that may be found desirable at any time. If such a system can be found that is not more costly than it is worth, by all means let it be applied. But in the meantime the allowing of the fresh sewage of Hobart to run into the estuary of the Derwent, in the manner provided for in the report, cannot cause any harm or inconvenience. In connection with this subject will you allow me to quote the following paragraphs from my report: –

OUTFALL ARRANGEMENTS—TIDAL ACTION.

At the respective outfalls, arrangements would be made for discharging when necessary at all states of the tide. Thus, if desirable, the sewage could be discharged at about half ebb so as to insure its being carried out of Sullivan's Cove and Sandy Bay. This, however, would only be necessary at the Battery Point outfall, and even there, the harbourmaster tells me, it is only at exceptionally high tides that the flood sweeps round into the cove. According to the Admiralty chart, the half ebb runs down at $1\frac{1}{2}$ knots an hour opposite Macquarie Point, while opposite Battery Point the half flood flows up at $\frac{3}{4}$ of a knot only. The harbourmaster thinks the latter rate overstated, as there is usuually only flood enough to counteract the downward flow of the river. However that may be, it is evident that there is opposite Hobart an almost continuous downward current carrying water out to sea, and that this so greatly exceeds any occasional upward flow of tide as to remove any danger that sewage matter would be kept floating up and down opposite Hobart. In this respect Hobart differs from many other towns on tidal rivers,—Brisbane, for instance. In dry weather the Brisbane River is not appreciably affected by the downward current of fresh water from a comparatively limited catch-water basin, with a small rainfall. The upward flow of the tide is apparently as strong as the downward ebb. Consequently the Brisbane at the city has the character rather of a land-locked arm of the sea than of a river, and sewage flowing into it would float up and down until some strong freshet carried it away, and in the dry season this might not occur for months. The effect of this in a sub-tropical climate may be imagined. At Sydney, also, the Admiralty charts show that the upward flow of the tide is equal to the downward ebb, so that in position it resembles Brisbane; therefore, the consequences of the discharge of sewage at both places can never follow at Hobart. There is still less resemblance between the conditions under which this discharge will take place here and in the oft-quoted River Lea.

The River Lea is a small sluggish stream draining part of Hertfordshire and Middlesex. The lower part of it is canalised, and from the upper part of it the main supply of the East London Waterworks Co. is taken. The company take all the water except what they are forced to leave for working the navigation. The water thus left is to all intents stagnant, like that of all other navigable canals—the only current being that caused by the use of the locks. And as the river and canal receive the sewage of all the chief towns of Hertfordshire, and of much of London itself, it may be said that the whole affair at the London end is but a common sewer used as a canal, as the quantity of sewage it receives from a population of more than 20 times that of Hobart is there its main water supply. A population of 200 millions draining into the Derwent would not render it so noisome as the Lea, even supposing the former to be as stagnant as the latter. Consequently the case of the Lea is not one in point.

Again, after stating the fact that the total solid matter in the Hobart sewage would be 10·35 tons daily, of which 1·66 tons would be solid fæcal matter in a state of dilution of one part in 4,400 of water, the report goes on.

CONDITIONS OF DISCHARGE.

Another point in connection with this matter has to be considered. The above given rate of dilution of the sewage is that in the sewers before discharge: what will be its condition after discharge? The accompanying plan shows that it is to be sent into the tideway of the estuary. The capacity of the basin of the estuary in front of Hobart and between the outfalls is at least 60,000,000 (sixty million) tons. This quantity of water is in continual motion from the action of wind and tide and the downward current of the river. This downward current is caused by the flow of the drainage from about 3,000,000 acres of land—a flow equal to a daily average of 15,000,000 (15 million) tons of fresh water, being seven times that in the Thames at London. It is evident that the action of this downward current and of the tides must change a great part of the water in this portion of the estuary every day. What would be the effect of turni g $1\frac{2}{3}$ tons of solid fæcal matter in the above-described weak solution into this immense body of continually moving and continually renovated water It certainly would not be appreciable. Water is considered pure and wholesome for drinking purposes when it does not contain more than one part in 4,000,000 (four million) of combined nitrogen. But the estuary water cannot be used for drinking, and even if it could, the sewage would not add to its combined nitrogen one part in 40 millions. I have, therefore, no hesitation in recommending that this part of the sewage should be treated as the rest, and together with it be conveyed by the sewers into the tideway of the estuary.

LIVERPOOL SIMILARLY SITUATED TO HOBART.

The position of Liverpool is very similar to that of Hobart; it being also situated upon a tidal estuary. But the population of Liverpool is more than 26 (twenty-six) times that of Hobart, and the area of land forming the drainage basin of the Mersey is not half that of the drainage basin of the Derwent, so that the mean outflow of the former cannot be more than half that of the latter. Moreover, the Mersey is already polluted above Liverpool with the sewage of more than 2,000,000 (two million) people: the Derwent above Hobart does not receive that of 20,000 (twenty thousand.) Liverpool is now altogether a water-closet town, drained into sewers which discharge into the estuary; and notwithstanding all the above circumstances—so incomparably more adverse than those of Hobart—no inconvenience is felt either

in regard to the public health, or to that other matter of vital importance to the second port of the world—its navigation. It is true that Liverpool ranks high in regard to its death-rate, but it is, excepting London, not only the most populous city in the United Kingdom, but the most thickly populated. Seven times more people are crowded upon each acre of its area than is the case in Hobart ; and such overcrowding has had its inevitable result. But the sewerage works undertaken, and the compulsory introduction of water-closets, have greatly reduced and are still reducing the death-rate. And not only so, but the action of the system, by raising the character of the occupiers of the lower class of tenementary property, has satisfied house-owners that the money expended in carrying it out has been profitably spent.

Since the above was written I have seen in the *Lancet* of the 12th of June a notice of Dr. Stopford Taylor's report on the sanitary condition of Liverpool for 1885, and the following facts and observations are taken therefrom :—The average annual death-rate of Liverpool for the 10 years 1841-50 was 36 to the thousand, it is now 23·7. If the death-rate had continued even at the decreased mortality rate of the 10 years, 1851-60, Liverpool would, last year, have lost 3,917 more lives than were lost. And if, as is usually assumed, there are 10 cases of illness to every death, there were in Liverpool last year 39,000 less cases of disease than the average of the time before sanitary works were undertaken. If the calculation of the late eminent actuary, Dr. Farr, be correct, that the average value of every life to the community is £159, after making the necessary deduction for the mean value of his subsistence during the various periods of life, and in its various conditions, Liverpool saved last year £622,803 in monetary value of life alone, without taking into account the contingent savings of expenditure for the illnesses above mentioned, of loss of work, doctors bills, funeral expenses, etc.,—contingent savings of at least equal value. I commend all this to the consideration of those who think all expenditure under the Health Act as waste of money.

One other point in connection with the discharge of sewage into the Derwent remains to be considered. As has been already mentioned the sewage of Hobart is already discharged there, and will be so whether water-closets be constructed or not, but at present it is mixed with street sewage containing heavy mineral matters. This, in most cases, first flows from the gutters into the various rivulets, along the borders, and among the stones of whose channels it is partly deposited, as their offensive condition shows. These rivulets enter the harbour at various points, none of which are in the direct tideway, consequently the matters brought along by the current of the rivulets getting into comparatively still water are quickly deposited—the matters being road detritus mixed with coagulated grease, soap-suds, and fæcal matter, and the banks formed by the deposit are consequently composed of these matters. Every time there is heavy rain it washes the borders and beds of the rivulets, and carries down some more detritus mixed with these washings, and deposits them on the banks in course of formation. The banks thus formed being of sand and earth mixed with putrescible matter are certain to become offensive.

But under the proposed system of sewers the condition of things will be quite different. The sewage will be unmixed with sand and earths It will only hold in solution and suspension matters of about the same weight as water, consequently there will be no tendency to form banks by immediate deposit, and the sewage will be discharged into the tideway. The rivulets will naturally continue to bring down sand and earth, and that cannot be helped, but the sand and earth will not be putrescible, and consequently will not be noxious either while

being deposited or while being removed. Neither will the effluent sewage be as offensive as the tar allowed to escape from the gas works. Tar will not mix with water but floats on the surface, and is carried wherever the winds take it, whereas sewage is carried only by the current, and within a short distance from the outlet it will be mixed with and form part of the general mass of water. Certainly steps ought to be taken to keep tar and ammoniacal liquors out of the estuary or they will destroy the fisheries. As to the effect of sewage upon the fisheries let me finish by quoting again from the *Lancet* of the 12th June :—"Finally, when the throwing of the sewage into the sea is stigmatised as a ridiculous waste, the arguments of Sir J. B. Lawes, as to the cultivation of the fish supply must not be left out of consideration. According to that distinguished authority, the sea harvest derived from the discharge of sewage into an estuary may sometimes be more valuable than any possible land harvest."

Mr. W. Saville-Kent, F.L.S.,F.Z.S. contributed two papers. 1. On a suspected hybrid species of Trumpeter, and upon other rare fish taken in Tasmanian waters. 2. Note upon the occurrence of the Sydney Crawfish, *Palinurus hügellii*, on the coast of Tasmania.

In the first paper an account was given of an unfamiliar variety of Trumpeter that had been captured by the fishermen on the east coast, and that had been kept alive for some time in one of the tidal ponds of the Fisheries' establishment. While the general colour, a distribution of the markings on the body, corresponded closely with those of the ordinary Silver Bastard Trumpeter, *Latris Fosteri*, the general contour and the greater portion of the structural details agreed more nearly with those of the Real Trumpeter, *Latris hecateia*. Compared with that species, it coincided in the possession of 17 rays to the anterior or spinous portion of the dorsal fin, in the number of scales, 110, developed in the lateral line, and in the presence of teeth upon the vomer, though these were fewer in number than are found in the last-named species. In the Common or Silver Bastard Trumpeter there are only 16 spinous rays to the anterior division of the dorsal fin, the scales along the lateral vary from 115 to 120, and there were no teeth whatever upon the vomer. A comparison made with the structural formation of the New South Wales or New Zealand Trumpeter, *Latris ciliaris*, demonstrated that the specimen was more nearly allied to *Latris hecateia* than to that species, though at the same time it could not be precisely identified with any of the species of the Trumpeter genus hitherto recorded. Taking into account the occurrence of the specimen described as an exceptional example, and giving full value to the remarkable manner in which it combined the characteristics of both the Real and Silver Bastard Trumpeters, the author of the paper was inclined to regard it as an accidental hybrid between those two species. Support to such an interpretation was afforded by the known parallel cases of hybridism that naturally occur or may be brought about by artificial means among species of Salmonidæ. The greatest obstacle to the interpretation was associated with the character of the dentition, there being only two teeth in the vomer in the case of the supposed hybrid form compared with a group of six or eight found in the Real Trumpeter. Should further investigations satisfy icthyologists that the two-toothed variety of the genus *Latris* represented a new and independent species, it was proposed to distinguish it by the title of *Latris Mortoni*. The second fish described was a representative of the family Blennüdæ, and referable to the genus *Clinus*, of which one species only *C. despicillatus*, has been recorded as inhabiting Tasmanian waters. This species is a fish 4 or 5in. long, commonly found in rock pools at

low water, and included among the species commonly known as "Bullies." The new variety introduced is 14in. in length, very handsomely coloured, and differs in the character of the tentacular appendages, and other essential points, from the species hitherto described. It was proposed to distinguish it by the title of *Clinus Johnstoni*. A third fish apparently belonged to the tribe of the Squammipinnes or scale-finned fishes. It had been anticipated that it was identical with the single known representative of this group, *Scorpis Georgianus*, that has hitherto been taken, and that very rarely, in Tasmanian waters. On a closer examination of the structural details it was however, found to differ esesentially from that form, and belonged to the genus *Glyphidodon*, and be referable to *G. Victoriæ*, or Rock Perch of the Melbourne fishermen, not hitherto included in the Tasmania fish fauna.

Life-sized coloured illustrations of the several fish described, executed by the author of the paper, were exhibited to the meeting.

The second paper described the capture of the example of the New South Wales crayfish (*Palinurus Hügellü*) in the vicinity of the Schouten Islands. Other specimens were reported to be occasionally taken by the fishermen, who, thinking from their colour (greenish brown) that there is something wrong with them, usually throw them overboard. The points of distinction between this type and the ordinary market species of this colony, *Palinurus Edwardsii*, were pointed out by Mr. Saville-Kent, who, in conclusion, presented this and other of the specimens previously mentioned to the Museum.

Mr. R. M. Johnston said the specimen was most closely allied to the real trumpeter. He was not sure of the number of teeth in the real trumpeter, but from casual observation he believed it varied.

Mr. Morton (the curator) said he was sure the trustees of the Museum would be deeply thankful to Mr. Kent for presenting the fish and crustaciæ on the table, and he trusted they would be the forerunners of many other valuable donations which Mr. Kent, from his position, would be able to make. By these means a collection of all the known species in Tasmania would be got together. He had been examining a number of real trumpeter recently, and in no case was the dentition similar to the specimen presented.

A circular was read from the Royal Society of Victoria and the Geographical Society of Australia, asking the co-operation of the society in acquiring Antarctic information and pursuing Antartic discovery.

On the motion of Mr. Sprent, the consideration of the paper was postponed till next meeting, when he hoped to bring up a paper embodying the reliable information that could be gathered.

On the motion of Mr. B. Shaw, seconded by Mr. C. J. Atkins, a vote of thanks was passed to the Fellows who had contributed papers, and the donors of books and specimens.

SEPTEMBER, 1886.

The usual monthly evening meeting was held at the Society rooms on Monday, September 13, Mr. Jas. Barnard in the chair. There was a large attendance of Fellows, and many visitors, including a number of ladies.

The following gentlemen were elected corresponding members of the Society:—Mr. R. L. Jack, Government Geologist of Queensland;

Dr. B. Carrington, M.D., F.R.S.E., Eccles., Lancashire, England, and Mr. W. H. Peason, Manchester. Drs. Hardy and Wolfhagen, of Hobart, were elected Fellows of the Society.

The following donations to the library were announced :—

American Agriculturist, August.

Annals and Magazines of Natural History, No. C III., July.

Athenæum, June.

Boletim da Sociedade de Geographia de Lisbon, 5th series, No. 9, 10.—From the Society.

Bollettinodella Societa Geografica Italina, serie II., vol. XI.—From the Society.

Bulletin de la Sociéte Royal de Botanique de Belgique Tome Vingt—Cinqinème Fascicule Premier Année, 1886.

Bulletin de la Sociéte Imperial des Naturalistes de Moscow, No. 1.—From the Society.

Bulletin du Musée Royale d' Histori Naturelle de Belgique Tome IV., No. 2.—From the Society.

Catalogue of the Library of the Linnean Society of New South Wales.—From the Society.

Field Naturalists' Club of Victoria, sixth annual report, 1886.—From the Society.

Geological Magazine, July.

Journal of the Bombay Natural History Society, No. 3, vol. I., July.—From the Society.

Journal of the Society of Arts, June.

Mineral Statistics of Victoria for the year 1885. Report of the Secretary of Mines to the Hon. J. L. Dow.—From the department.

Nature, June.

Proceedings of the Canadian Institute, Toronto, third series, Vol. III., No. 4, June, 1886.—From the Society.

Proceedings of the Linnean Society of New South Wales (second series), Vol. 1, Pt. the second.—From the Society.

Provincial Medical Journal, Vol. 5, No. 55.—From the Editor.

Sociéte de Geographic, Nos. 12, 13, 1886.—From the Society

Studien über Thonschiefer Gangthonschiefer und Sericitschiefer. I Thonschiefer und Gangthonschiefer des Oberharzes, by Von Herrin A. Von Groddeck in Clausthal.—From the author.

Statistical Register of the colony of Victoria for the year 1885, Pt. II, Population, Pt. III. Finance, etc.—From the department.

Transactions and Proceedings of the New Zealand Institute, 1885. Vol. XVIII. Do. do. Index. Vols. I. to XVII.—From the Institute.

Transactions of the Asiatic Society of Japan. Vol. XIV., Pt. I.—From the Society.

Uber die Gesteine der Bindt in Ober Ungarm. By Von. A. Groddeck.—From the author.

Verhandlungen der Gesellschaft Für Erdkunde Zu Berlin Band. XIII., No. 6.—From the Society.

Victorian Naturalist. Vol. III., No. 4. Aug.—From the Society.

Zur Kenntniss der Zinnerzlagerstätten des Mount Bischoff in Tasmanien. By Von. A. Groddeck.—From the author.

THE PROPOSED ANTARCTIC EXPLORATION.

A letter was read from the Premier covering a communication received from the Premier of Victoria, enquiring whether the Government of Tasmania would be disposed to join in the cost of dispatching an expedition to the Antarctic regions in the interests of science and commerce. The Premier noticed that the subject would engage the attention of the Fellows, and desired an expression of their views theron.

Mr. C. P. SPRENT then read a paper on the subject. He commenced by referring to what had been done in the Arctic Seas, and British enterprise and British adventure had been in the van, and to the vast field for discovery that lay around the South Pole. Since the last voyage to the Southern Polar regions, 43 years ago, science has made great strides, yet, beyond a few facts regarding a portion of the coast line, very little was known about those regions. But Baron Müller had introduced the consideration of a new scientific voyage, and the subject had been taken up, leading to the proposal the society was now met to consider. As one of the few members of the Geographical Society of Australasia, he had been requested to place those proposals more fully before the Royal Society. Mr. Sprent then gave a rapid *resumé* of the earlier Antarctic voyages, pointing out the courses sailed and the land discovered on a large chart prepared for the purpose. He then gave an account of that English expedition of 1839-40, pointing out that Ross had achieved the remarkable reputation of having discovered the South as well as the North Magnetic Pole. Having given account of what had been done, he proceeded to point out that the Antarctic regions presented the exactly opposite characteristics of the Arctic regions. The Great Northern region was connected with the continents of Asia and North America, but the great Southern region was cut off from any communication. It was doubtful whether the Antarctic region was a continent or a collection of islands joined together by ice. The balance of testimony was in favour of the latter supposition. The icebergs of the South were different from those of the North. Antarctic summer was colder than the Arctic There was a want of information regarding the cold of the Antarctic region, but there was some evidence that it was colder than the Arctic. The geology of the Antarctic land was only known through scattered fragments, obtained, in some instances, from such strange places as the stomachs of penguins. So far as he was aware no fossils had been obtained, and very little stratified rock has been seen. The rocks were chiefly volcanic, and the specimens obtained included greenstone, granite, basalt, hornblende, slate, mica slate, schists, etc. Seeing that no one had set foot in Antarctic land there was no evidence as to whether any land animals existed there. Whales, seals, and albatrosses were numerous, though the officers of H.M.S. Challenger reported that the Americans were fast thinning off the seals. In concluding an excellent *résumé* of what is known regarding the Antarctic regions, Mr. Sprent said:—"It now remains for me to answer the two questions that must inevitably be asked when any proposals for further exploration in the Antarctic are put before the people of these colonies:—1. What is the good to be expected from it? 2. Why not leave it to others to try? In answer to the first question we may reply that, independently of any commercial advantage that may result we must look to the scientific knowledge to be acquired, and it is now generally conceded that the value of scientific investigation is not to be measured by mere pecuniary results. There is a numerous body of scientific men, whose business it is to acquire information, to collect facts in various lines of enquiry, and to establish principles. No one can tell what the ultimate results of any particular scientific investigation may be, what practical advantages may accrue from pursuits which at one time seem purely theoretical. The advantages derived by the world at large from the application to every day use of steam, electricity, magnetism, heat, sound, followed after long investigation of principles. Surgery, medicine, chemistry, hygieny, are all benefiting by the labours of men who were looked upon in their day as enthusiastic theorists. Literature, art, and science are not calculated solely for money profit. In this Society we have a zealous band of workers energetically striving to increase our knowledge of

geology, botany, and natural history of the island we live in ; their labours do not add to the value of our exports, nor add to the pecuniary wealth of the people ; but they are none the less valuable, and we look with pride on our little volume of transactions as our modest contribution to the ever-accumulating stores of scientific knowledge. The programme for the proposed Antarctic voyage, as sketched out by our Victorian *confrères*, presents a varied and numerous array of subjects for investigation, subjects on which additional information will be welcomed by the scientific men of all countries. The commercial advantages, too, are sufficiently promising to have induced the Victorian Premier to lend his powerful support to the movement, and I notice that the Premier of Queensland approves of the project, although he doubts if the time is opportune ; and seeing that the Geographical Societies of England, Germany, Italy, and Denmark, are all anxious to see the work undertaken, I think we may rest assured that some good results will follow, and that we shall be in good company if we join in the work. Lastly, it is incumbent on Australia to take part in this exploration. We aspire to be the leading power in these Southern Seas; we are gradually setting up a Monroe doctrine of our own ; and we are working ourselves into a perfectly hysterical condition at the bare thought of Frenchmen or German poaching upon what we consider our preserves. All this may be very good policy if we can persuade other nations to see things as we do, but we must make up our minds to act as well as talk, and that it is useless for us to expect the whole force of the British Empire to be exerted in favour of our schemes, unless we can prove that our aim is calculated to promote the welfare of the Empire as well as our own. If we expect to be the ruling power in these seas, the sooner we show ourselves upon them, the sooner we shall see our claims recognised, and it is only by fostering a spirit of adventure and enterprise that a maritime power can be built up. The great commercial Empire of Great Britain was forwarded by adventurers, who, in the days of Queen Elizabeth, made their way into newly-discovered lands, establishing themselves in the most promising regions, and defying all efforts to dislodge them. If we wish to build up a maritime power we must follow their example, and if we wish to preserve the islands of the Pacific for our commerce we must turn our attention to forming an Australian navy, and show the Mother Country that we are able to hold what we may acquire. Australia has already shown the Mother Country that she is prepared to share the dangers as well as the benefits of our connection ; let us now show her that we are ready to send an Australian Contingent to share her work of science ; if we do we may be certain that in this line there is more lasting honour to be gained than in fighting the battles of the Old Country against half armed savages. No time is more opportune for such a demonstration than the present, when the colonies are so prominently before the public of the world. We have shown the rapid progress of our commerce, and the vastness of our resources ; we have proved that in manly sports we can hold our own with all comers ; now let us show that the old Anglo-Saxon love of adventure is strong within us, and that although during our infancy we were content to share the benefits of scientific work, in our manhood we are ready to share the toil. The scientific world is anxious to see a renewal of Antarctic exploration, and nothing would be more gratifying to them, nothing will be more calculated to give the world an earnest of our desire to help, than for Australia to take up this work ; certain it is that it would be a standing disgrace to Australia if she took no part in the exploration of the seas that wash her own coast, and if Australia determines to undertake this work, I trust that this time Tasmania will act with them." (Applause.)

Mr. J. B. WALKER said he had been requested, in order to test the matter and ask the Government to take part in any expedition that might be sent out by the Australian colonies, to move the following resolution :—"That in the opinion of this meeting it is desirable in the interest of science and commerce that the exploration of the Antarctic regions should be reviewed, and that in the event of the Australia colonies taking part in the despatch of an expedition for that purpose that Tasmania should contribute towards the cost." He quite concurred in Mr. Sprent's remarks as to the responsibilities Australia incurred if she intended to hold the empire of the Southern Seas. If she wanted the position she should take up the responsibilities that were attached to that position. We should do our share towards the scientific resources of these Southern regions as England had done in the North. Tasmania should not be the only colony to stand apart from such an enterprise as she had done in the case of the Colonial Exhibition. The space to be explored was double the size of Australia, and certainly presented great opportunities for scientific research, and presented such opportunities to us in a way in which they were not open to any other part of the world. It was 50 years since the last expedition was sent out, and since then much has been done to render such an exploration feasible. He would leave it to those Fellows, better able than he was, to explain the scientific gains which might be anticipated as the result of such an expedition, but desired to point out some commercial advantages that might result in the way of opening up a new industry in whale fishery. He pointed out the 25 years ago the late Dr. Crowther despatched a vessel to Kerguelen Island, in the whaling interest, so that it would be seen that Tasmania had taken up the matter before, though not very successfully.

Mr. A. MORTON (Secretary of the Royal Society), in seconding the motion, said he was sure they had all listened with great pleasure to Mr. Sprent's interesting paper, and he thought the meeting was entirely in accord with the resolution. It was pleasing to notice that the Royal Society of Tasmania was the third scientific society in the colonies to take up the matter. Victoria led the way, Tasmania followed, and he believed New South Wales would shortly consider the same question. As they all knew, in about 15 months the centenary of, we might say, Australasia would be celebrated, and it would be a fitting time for her to show the world that she had arrived at her maturity, and was able to take her place with the nations in organising a scientific expedition. Before America was a hundred years old she had sent out expeditions to the Arctic regions, and no fitter celebration of our centenary could be devised than a successful venture of this kind. He pointed out that the Premier of New South Wales had brought forward a proposal to celebrate the hundredth birthday of Australasia, and as the British Association had been invited to hold their meetings in the colony in the year 1888, such an expedition successfully carried out would show them and the world what the Australian colonies could do. He, for one, though preferring to explore in warmer latitudes, would be very glad to take part in a scheme which would be so beneficial scientifically and commercially. The colonies had the means and the men ; let them have the will, and success was certain. (Hear, hear.)

Mr. A. MAULT suggested that the motion should be slightly amended, to read that Tasmania would give a general co-operation and not only contribute towards the cost. It would be better for Tasmania to be represented and to take a more active part than in merely contributing towards the cost. In these days, when federation was the common hope, an Australian navy was the great want, and such an expedition as that proposed was the kind of training to make good men.

The Rev. J. B. Woollnough, in support of the view that such expeditions nourished a spirit of adventure and made hardy men, referred to the fact that France used the shores of Iceland as a nursery for her marine, both commercial and fighting.

The resolution was then amended to read: "That in the opinion of this Society it is desirable in the interest of science and commerce that the exploration of the Antarctic regions should be continued, and that Tasmania should co-operate with the other Australian colonies in the despatch of an expedition for that purpose, and that the council communicate this resolution to the Premier.

The Chairman, in putting the resolution, said his name having been mentioned in the early part of the paper, he might be pardoned if he indulged in some reminiscences connected with the return of the first expedition under Captains Ross and Crosier. It seemed that he enjoyed the distinction—if it be a distinction—of being one of the only two remaining members of the original Tasmanian Society, founded by Sir John Franklin; the other member being our esteemed honorary secretary and vice-president, Dr. Agnew. He had the privilege of sitting next to the distinguished commander of the expedition at the hospitable board of Sir John Franklin, and hearing from his own lips the account he gave of the discovery of a volcano on Mount Erebus—an appropriate name—12,400 feet above the level of the sea, in active eruption, and Captain Ross described it as a magnificent spectacle; and at a distance of about 20 miles there was also an extinct crater on Mount Terror at an altitude of 10,000 feet. The ships sailed here along a wall of ice fully 150 feet high for nearly 500 miles, when further progress was stopped by a complete barrier of ice. The description of these discoveries had left an indelible impression on his mind. Referring to the Society, the Chairman designated it as unique in its character, as the members were not called upon to make any contribution to its funds, but the whole expense, including the printing of its transactions, was defrayed by the generous liberality of its President and his noble-minded lady; and, indeed, the Society had a rosy time of it, as its members were entertained at Government House monthly at dinner before adjourning to the library for the reading of papers. Of course the number of members was then only a handful, or rather "table-full." Those papers are contained in the "Tasmanian Journal of Science," and many are of first-rate excellence, and well worth reading at the present time. The Chairman then referred to the excellent and exhaustive paper which had been read by Mr. Sprent, and expressed his full concurrence in all that had been advanced in support of the projected expedition, and especially agreed with the remarks of Mr. Morton that such an undertaking would commend itself to the people of New South Wales as one worthy to celebrate the centenary birthday of Australasia. In conclusion, he hoped that the expedition would be successfully carried out in the interests both of science and commerce.

The resolution was then agreed to.

The Rev. Geo. Clarke moved a vote of thanks to Mr. Sprent for the very able and interesting paper he had read for their instruction. He hoped Tasmania would always take a part in such matters, and never again incur the disgrace that attached to her for not being represented at the Colonial Exhibition. There were special reasons why Tasmania should co-operate in the movement, for Hobart would be the probable point of departure.

The Rev. T. M. O'Callaghan seconded the motion, which was carried by acclamation.

MISCELLANEOUS.

A woodcut engraving of Sir John Hooker, the botanist of the Erebus, in his study at work, was handed round for inspection.

The Secretary drew attention to some specimens of Fijian pottery

presented by Sir Henry Wrenfordsley, which were on the table. The jugs and cups were copies of European work, but there was one original specimen of ceramic art.

SPECIAL MEETING.

A special meeting of the Royal Society was held on Monday evening, September 27, for the purpose of continuing the debate upon Mr. A. Mault's paper on an underground drainage system for Hobart.

Mr. JAS. BARNARD occupied the chair, and there was a large attendance of Fellows, besides several visitors from the other colonies.

The debate was resumed by Mr. R. A. Bastow, who read the following paper in reply to Mr. Mault's :—

Mr. Chairman and Fellows of the Royal Society,

At the monthly meeting of this society, held on the 10th of last month, a paper was read by Mr. A. Mault on the drainage of Hobart. It was then intimated that I might have some remarks to make on that important subject, and I have now the honour of placing them before you.

In that paper many statements were made, which, if true, would be anything but pleasant to the residents of Hobart as matter for contemplation, notably, that all the once limpid watercourses of the city are now converted into common sewers, a fact that is patent in all cities and towns of any importance; that we have in our midst about 3,500 horrid cesspits, stinking, pestilential, seething masses of corruption, continually giving off gases of a most disgusting nature and poisonous in a high degree, but we are pleased to be able to say that the tenure of such state of affairs is rapidly shortening, and will soon be determined; that the contour of the city is such, that it is impossible to drain many properties without passing through the adjoining owner's premises, but here again, if no other course can be adopted, we have an excellent provision in section 137 of the Public Health Act, whereby drains may be made through private premises, and that the profitable conversion of the contents of pails into manure is problematical. These deserve serious consideration and most careful inquiry from every point of view, peradventure we may at least find out one system, or parts of many, that may be the simplest, the cheapest, the most efficient, for the preservation of the public health.

The official report to which Mr. Mault refers contains an elaboration of an extended system of sewerage, which, if it could be carried out, would undoubtedly be an immense improvement on the existing state of affairs. Inspecting the streets of this city, as it is my duty every day, in wet as well as in fair weather, if one fact stares me in the face strongly amongst others, it is that we require good underground drainage, and if the system of drains without the trough closets, as are laid down on the map accompanying the report, could be constructed for £60,000, and if the corporation had £60,000 laid by, and had nothing else to do with it, I do think that the citizens of Hobart would desire, and I scarcely think the corporation would then refuse to carry out, that great scheme of sewerage; or if the Central Board would take upon themselves to provide us with such a system of drains without trough closets, and would pay the costs, no doubt the citizens would be very much obliged to them; or if they could induce our Government to take the risk and foot the bill of such an undertaking, the inhabitants of Hobart would for ever bear them in grateful remembrance.

I have been careful to introduce the four "ifs" in the preceding paragraph, for thereon hangs the possibility of the scheme being carried out. But the municipality has not £60,000, the system cannot be

carried out for £60,000, and neither the Central Board nor the Government, if they are separable, will pay off our scores.

It has just been stated that the system cannot be carried out for £60,000. In order to justify such a statement, we must glance at a few of the details. Of course we are all aware that Mr. Mault's report is but a sketch, and that the figures are not intended to be taken as absolutely exact, but in these my remarks I have, rightly or wrongly, nevertheless as correctly as I am able, with the time I have at my command, arrived at somewhat different conclusions as far as regards cost of sewers.

Noticing only in the estimate for sewers. No. 1. Egg-shaped brick culvert, 3ft. 6in. by 2ft. 8in. inside measurement, it is priced at 42s. per lineal yard; and as excavation, shoring, bedding, centreing, bricks, cement, filling-in, and ramming and metalling, are not mentioned as being in part excluded, I take it that the 42s. is meant to include all the expense attached to each item in that No. 1 estimate.

I presume that the largest sewer will be constructed with its crown 4ft. below the surface at the very least, the depth of the excavations then required will be 9ft., and the width will be at least 5ft.; that will amount to five cubic yards of excavation in a treacherous subsoil, probably at times cutting through solid rock; this, with the shoreing, filling in, ramming, metalling, and carting away, should be worth at least 7s. 6d. per cubic yard, or £1 17s. 6d. per lineal yard. The bricks for the sewer would cost £1 7s. 9d., the cement for the sewer and sewer bed £1 7s., and calculating only 15s. for bedding, centreing, and laying the bricks, we have a total of £5 8s. 6d. per lineal yard for No. 1 sewer, or more than double the price mentioned in the report.

But if the localities where this sewer is indicated have a subsoil of blue metal or sandy or unmade ground (for according to Mr. Mault's map much ground of this nature will be met with in laying No. 1 sewer), I have it on excellent authority that the cost would be, not 42s. per lineal yard, nor yet my estimate of £5 8s. 6d., but 200s. per lineal yard.

If the remaining prices are similarly low, the total estimate of £60,000 must be considerably increased.

Usually, the streets in which underground sewers are laid have the gas and water mains laid at the same time, and the streets are then paved with setts; this protects the sewers from being choked with street detritus, and the same course should be here adopted. The systems of sewers and pipes should be laid at or near and under the side channel, so that any interference with the carriage way when once made would be unnecessary. But to pave 37 miles of street would be an enormous outlay for a scattered city like Hobart, sufficient to make the most extravagant pause and consider whether the existing sewers may not, with repairs and additions, be made to serve all our purposes for many years. A thorough inspection and subsequent repair, or, where required, a renewal of the existing sewers is without doubt desirable, but it would not be judicious to rush into the magnificent expense of large English cities when we do not possess their magnificent resources.

If underground sewers were laid in the principal natural watercourses that are as yet without them, and if good cement-concrete side channels were laid, with their inlets to the underground sewers properly trapped and regularly flushed, automatically or otherwise, it is probable that not much, if any, nuisance would arise therefrom.

* It appears, according to Mr. Mault's report, that there are about

* It has just been ascertained that in this city there are now only 1,278 cesspits existing. The pail closets number 2,965, and waterclosets 514. Oct. 13, 1886. R.A.B.

3,500 cesspits yet existing, and it has been recommended to have these replaced by brick trough closets, such as are in use at Liverpool. The cost of these has not been stated; but they could not be erected, and furnished with pipes, junctions, trough, brick walls, and other fittings, as shown on sketch, under the sum of £18 for each one, or a total cost of £63,000, this expense resting upon the owners of the houses to which the closets are added, and exceeding Mr. Mault's total estimate for underground sewers by £3,000. But, considered apart from the cost, such receptacles as advocated in the report, unless punctually attended to, would prove very offensive, and, however much attention they might have, accumulations would collect on the sides and edges, which practically could never be cleansed. Referring to waterclosets generally, my experience in Manchester has taught me to regard them with a very jealous eye. They appear to be directly opposed to the first principles of sanitary science, and should only be tolerated in large and lofty buildings where the adoption of the dry system is practically impossible, and then they should be separated by an open air space, and the ventilating and other pipes carefully supervised.

We are aware that the patent wash-out pan looks cleanly, and is in a certain sense convenient, but speaking as a sanitary surveyor, and using metaphor, it is typhus and typhoid fever garbed as an angel; I should not have to go away from Hobart to reduce this metaphor to hard fact. In the city of Manches·er this has been proved scores of times. The officer of health for that city states in his report for 1869, with regard to waterclosets and grids, that "no trap as ordinarily constructed is proof against the passage of sewer gases. The water which forms the valve becomes saturated with the gases (sulphuretted hydrogen, etc.) from below, and gives them off again above into the cellars or other apartments. There is no such thing as permanent retention of gases by water except under pressure. There is constant absorption on the one side, and constant elimination on the other."

The noxious quality of evolved sewer gas, assisted as it is in its evolutions by the bungling of plumbers, causes more sickness and death in first-class houses than the generality of the inhabitants of such houses dream of.

I would here mention that there is room for legislation with regard to allowing workmen to interfere with lead-piping in houses unless they are duly qualified and authorised.

It is certain that the "residuum" would not rise to the occasion in the use of the trough. Bundles of rags, and vegetable and animal refuse, would assuredly find their way into the trough pipe, just as they do in the pail or the cesspit, but in the former they are not easily removed; we should then have stoppage, nuisance, and expense to all connected with that sewerage area, both above and below the stoppage.

As Liverpool is a water-closeted city and Manchester is a dry-closeted city, it would perhaps be useful to compare the death rates as far as we can obtain them. The infant mortality per 100,000 persons under 5 years of age, from 1851-1860 was for Manchester 11·7, for Liverpool 13·2; under 1 year of age, Manchester 26·1, Liverpool 27·7; from 1861-70, under 5 years of age, for Manches- ter 11·1, for Liverpool 13·9; under 1 year of age, for Manchester 25·0, for Liverpool 30·5. These are from the figures of the Registrar-General, as quoted in the report of the officer of health, Manchester, 1876, p. 35. The death-rate per 1,000 for the whole town of Liverpool in 1880 was 27·3; for the city of Manchester 25·99, this including 659 deaths which occurred at Crumpsall workhouse near to Manchester, and which should not have been included. By these facts the system of Liverpool soil pipes stands condemned.

I should have included the death- rates of these centres of population for the succeeding years if the Registrar-General's reports had been in the Parliamentary Library.

In case of epidemic raising, there can be no doubt but that a system of drainage to which all the closets of the city are connected is a most favourable condition to its rapid spread. We again bring forward trough-closeted Liverpool as an example. When small-pox had become rife in London and Liverpool in1872, it became certain that Manchester would not escape, as the intercourse with Liverpool especially was constant and active. The City Council then issued printed instructions to 19 sanitary inspectors, and I copy the following as instructions Nos. 2 and 3 :—

2. "He shall represent to the inhabitants of each house that small-pox has for many months past been exceedingly prevalent and fatal in London and Liverpool, and in several other large cities and towns; that during the week ending Saturday, May the 20th, the deaths from small-pox were in London 267, in Liverpool 50, in Newcastle 14, and in Manchester 10. That the annual death-rate from small-pox in Liverpool is equal to 5 out of every 1000 persons living in Liverpool.

3. "He shall also represent to them that small-pox is rapidly increasing in Manchester and Salford, owing partly to the infection being brought from Liverpool, and partly to the spread of infection from persons already suffering from small-pox in Manchester and Salford; and that unless measures are taken to check the spread of the infection it is likely to be as bad, that is, as prevalent and fatal in Manchester as it is in Liverpool and London." The Liverpool system of soil pipes again stands condemned. Had Liverpool been furnished with dry closets in place of waterclosets it is probable that neither Liverpool nor Manchester would have suffered so severely from epidemic. In the latter city, where dry closets were adopted, the spread of small-pox was rapidly and efficiently checked.

It is a patent fact that the general public are perceiving the dry closet to be the natural process to be adopted, and if those who have such dry closets and do not burn coal could be by law compelled to use ashes, or other material as an absorbent, there would be an end to all nuisance from the closet. A small amount of ashes or dry earth will completely deodorize and absorb the moisture in the pail, and this may be dried and used over and over again if necessary. The pail cannot be used to contain all the slops of a household, but these may be profitably carried into gardens or orchards by a system of sub-irrigation carried out on a small scale. The slops should be led from the house to the garden through a water-tight pipe, and from it three or four rows of sub-irrigation drain pipes should be laid about a foot deep in the soil and ⅜ of an inch apart. The rows of pipes thus laid should be used on alternate days, and it would be found that the soil will greedily absorb all the slops of a large house, if this means is adopted. An earthenware (Field's) flushing tank at the house would automatically deliver the slops to the extent of the pipes. This system is thoroughly described in "Our Homes, and how to make them healthy," by Shirley F. Murphy, p. 671., the chapter in question being written by William Eassie, C.E., F.I.S., F.G.S.,etc. A small drainage scheme of this nature was carried out by Mr. Bailey Denton for 13 houses, a mansion, and a farm homestead near Leatherhead, Surrey, with great success. The irrigated land is in close contiguity to the mansion, but no nuisance is experienced from it. Previous to these alterations the slops decomposed in the neighbouring ditches, and caused considerable nuisance. In many cases in this city a rough and ready system of this character is adopted, and serves the purpose admirably, but where the contour of the ground prevents the adoption of such a method the house

slops must of necessity run into the side channel, and it should then be regularly or automatically flushed, nuisance will then be prevented. Some time ago I stated in this room that the great reduction in typhus and typhoid fever cases and deaths in the city of Manchester was synchronous with the alterations effected in the closets of the city, from the cesspit to the dry system. The following are the years in which the Health Committee have been at work, and the results are interesting as a record of lives saved by sanitary operations :—

Year.	Deaths from Typhus and Typhoid Fever.	Rate per 1,000 of population.
1868	635	1·83
1869	403	1·16
1870	392	1·13
1871	282	·80
1872	242	·68
1873	232	·66
1874	188	·53
1875	177	·51
1876	225	·63
1877	164	·46
1878	115	·32
1879	68	·18
1880	98	·24
1881	75	·21
1882	116	·33
1883	76	·21
1884	73	·21

The deaths from the five principal zymotic diseases within the same years decrease gradually from 2,342 deaths in 1868 to 720 deaths in 1884. It would, therefore, appear that the sanitary operations in that city must not be characterised as a disastrous failure, but as a glorious success.

In section 51 of Mr. Mault's report it is stated that the yearly cost of street sweeping and pail collecting for the city of Manchester is £87,000. Mr. Mault has been misinformed. The absolute cost of the department for 1884 was £86,814, and for that sum the following work was done :—£17,000 was spent in maintaining and looking after those afflicted with infectious disease ; 1,092 cases were taken to hospital ; 1,814 houses were disinfected and thoroughly cleansed ; 11,947 articles of bedding were disinfected ; 675gal. of medicine (diarrhœa mixture) were distributed at the police stations for the poor ; 6,691 barrels of water were used on the streets ; 270 horses, 100 carts, and 30 sweeping machines were kept at work ; 120 vans were washed every day ; 300 miles of courts and alleys were kept clean ; 900 miles of footpaths, and 475 miles of streets containing 64,283,502 sq. yards of carriage way were kept clean ; 52 public urinals were cleansed twice each day ; 90,000 street grids were opened and cleaned ; 54 private slaughterhouses were regularly cleared of refuse ; 50,000 dustbines were emptied once, twice or thrice, each week ; 66,000 closet pails were removed, emptied and washed, all once, some twice and some thrice, each week ; 217,274 tons of refuse matter were taken to the depôts and disposed of at a cost of £43,526 10s. 6d., and 117,455 tons of this consisting of street sweepings and pail contents. So that the sweeping and pail collecting, is but a small part of the sanitary operations of Manchester, and could not possibly cost £87,000 nor yet one half of that sum.

The report of the superintendent of the Health department, Manchester, for the year 1878 contains the following night and day soil account :—

Dr.			
To wages paid, night carters	£1,440	4	7
Ditto, barrowmen	3,371	5	10
Ditto, night yardmen ...	81	6	8
Ditto, tipmen	316	9	2
Rent of wharf, Bollington ...	5	0	0
Commission	239	15	2
Carriage	3,726	10	7
Wages paid, day yardmen ...	3,338	0	9
Ditto, vanmen and carriers...	12,448	13	0
Ditto, receptacle cleaners ...	1,287	17	0
General expenses	10,726	15	8
Total	36,981	18	5
Cr.			
By sale of manure	5,392	6	2
Balance	31,589	12	3
Total	36,981	18	5

The population was 341,414 last census, and according to this estimate of population the above outlay, equal to about 1s. 10d. per head, for not only pail collection and street-sweeping, but for the collection of all refuse within the city for one year. Applying that rate per head to the City of Hobart, with a population of 24,000, the total annual cost for sweeping streets, pail collecting, and the removal of all additional refuse, would amount to £2,200 per year, or £800 per year in excess of the present cost, not one quarter of the probable cost as estimated by Mr. Mault, viz., £9,000.

In section 14 of the report the annual cost of scavenging Hobart is stated as £2,000. The exact cost of this department is £1,347 10s. 11d.

I have a small plan of sanitary works, at Warrington, on the wall before you. Of this complete little work, W. Sedgewick Saunders, M.D., F.S.A., in his report to the Committee of the Honorable the Commissioners of Sewers of the city of London, 1884, and ordered by them to be printed, says:—"I think it must be conceded that in the new system we have before us a new line of departure of singular promise, and that by waiting for its full development we have been spared the risk and cost of failure, even if we cannot claim the honour of being the pioneers of a system destined in the opinion of all competent and disinterested sanitarians, to supersede the present vicious methods of disposing of house refuse;" "not only did they see a work consisting of poisonous and disgusting elements dealt with and satisfactorily disposed of, without nuisance of any kind, but learnt that products having a marketable value can be, and are, produced without any infraction of true hygienic principles, whilst at the same time they may have the effect of materially reducing the expenses."

I think that a similar system could be advantageously adopted in Hobart for dealing with refuse. The evaporation to dryness of semi-liquid excreta would afford excellent and portable manure, and the total destruction by fire of all other noxious waste material would probably be found to be cheaper and more efficient than any other process of dealing with refuse matter. I am glad to say that Mr. George Coppin, M.L.A., Victoria, and a member of the Victorian Central

Board of Health, entirely approves of the dry system, after having made special investigation of the subject in his recent visit to England.

But if we presume that underground drainage effected, and even dry closets adopted, the mortality of Hobart or any other colonial city will be reduced to the minimum rate, we shall arrive at a wrong conclusion.

Although I do not know much about waterworks, I do know this, that they are quite as important a factor in the public health as sewers, and they are at the present time receiving close attention. I should like to have referred to other subjects touching the public health, but there is not time. Old and dilapidated buildings should be demolished; all the cesspits in the public schools of the colony should be abolished; the streets should be paved with wood (Tasmanian wood), and then there would be an end to costly metalling; new slaughter-houses should be erected; infectious diseases should be energetically dealt with, and infected houses cleansed.

Filthy houses (where freshly vaccinated children have erysipelas or abscesses, and the fault is laid on the vaccine in place of being laid on the filthy house), require strict sanitary supervision, and many other measures too numerous to mention this evening, although of vital importance, all require consideration. These cannot be done by a waive of the hand, but they may be considered systematised, and gradually enforced, and with each step that is taken we may expect that the standard of health will rise.

At the conclusion of his paper, which was received with cheers, Mr. Bastow added, in reply to questions, that the system of altering the old cesspits into the dry-closet system was not completed when he left Manchester. With regard to the fact that water system was adopted in the Manchester Town Hall, he pointed out that the officer of health was appointed in 1868, and the health department was created the same year. The contract for the building of the town hall had commenced before then, and all the plans and specifications were completed some years before. If that had not been so, he would not have opposed the earth-closet for a building like that, which was seven or eight storeys high.

Dr. Perkins: But there are 11,000 waterclosets in Manchester at the present time.

Mr. Bastow: I believe that is so. Waterclosets are allowed to be built with the sanction of the Health department.

Mr. Morton instanced the case of Norwich, where the sewerage system was expected to cost £28,000, but after spending the second hundred thousand they were no better than when they commenced. With regard to sewerage affecting the fish at the fisheries exhibition, papers were read of the terrible results to fish in every river in Europe. He did not agree with Mr. Bastow's suggestion to pave the streets with wood, while, in Hobart, there was such a good supply of metal, and felt certain it would be very much dearer, while other use could be found for the timber all over the colonies.

Mr. E. Swan desired to know something of what was being done outside of the two Lancashire towns of Manchester and Liverpool. He would like to know what was being done in sanitary matters at Paris and other Continental cities.

Dr. Wolfhagen said it was undoubtedly a fact that typhoid was very prevalent in Hobart about autumn, and the fact required some consideration. In Edinburgh there was a lower death rate than any other European cities, except some to the extreme north. There the sewerage was taken out of the town and allowed to flow over some meadows, but there was a project to carry it by extensive sewers into the Frith of Forth. At Edinburgh the circumstances were very

similar to Hobart, where the city was built on several hills and close to the sea. Edinburgh was much more to the point in considering what should be done in Hobart than Manchester.

The Rev. J. B. WOOLLNOUGH said he was not an expert, but only an outside sufferer, with a great deal of experience, and very little knowledge. He was opposed to underground drainage, because it gave back the gases, whereas the land retained them. It was better to send these things to the soil, which wanted them, than to the water, which did not want them, and did not know what to do with them. He had lived in the Thames Valley, where the question had been fought for years, and was still being fought. They were there called upon to do something, and did something which was not right. At the Army and Navy Club in London he recollected there had been a difficulty with the water system, and in taking up a few boards the usual state of affairs was discovered ; and he had no doubt it would be as bad under Marlborough House and at other large mansions. He had never met a perfect watercloset, and it seemed to be hopeless to expect one. Whatever might be said about the troubles of the earth system, they knew what they were. Each box stood by itself, was comparatively harmless, and could not go far wrong ; but with the water system there was no knowing the extent of the mischief, as the evils of one place was carried around to the neighbours.

Mr. WARD gave some analyses of sewerage and the proportion of solids to be dealt with in disposing of sewerage under the watercloset system.

Mr. C. H. GRANT said he recollected when he first began to take an interest in engineering works, the Board of Health was established in England under Government auspices. It was very unfortunate indeed in its first efforts, as Mr. Mault would probably recollect. They created a special fever known as the "Croydon fever." At Eastburn, where they proposed to show what a system of public drainage should be, they were almost equally unfortunate. As a matter of fact no special disease had ever been attributed to the pail system. At Paris he recollected when he used to visit that city the pail system was carried out, and it certainly was not pleasant the way it was done. In Melbourne, too, it was very objectionable sometimes in the night. But these matters could probably be managed better than they were in those places.

The CHAIRMAN said, before calling upon Mr. Mault to reply, he desired to say something from his own experience. He did not think either system could be adopted to the entire exclusion of the other. It depended much upon the way in which the domestic arrangements were constructed, which was the best. He had the advantage of a garden and used a pit with pipes leading to it, from which the excreta was disposed of in the garden. It depended upon what conditions existed to determine which system was preferable.

Dr. HARDY thought Mr. Bastow had taken unfair illustrations in making out his case. To decide the question for Hobart by reference to any other place it was necessary to find a hilly town with great natural facilities, and with an immense body of open salt water around it. It was almost absurd to quote Manchester, where they had a ditch they had defiled, or even London, with the circumstances existing in Hobart. It was a new fact to him that small-pox was spread by the drainage. He believed typhoid and such diseases were, but had never heard of small-pox being carried about by the drains. He believed that Hobart ought to have a model death rate, something very far below anything in the other towns of Australia.

Mr. J. H. B. WALCH, in reference to Mr. Swan's question about other cities, pointed out Adelaide, where, since the establishment of underground drainage, the death rate had lowered considerably. Dr.

Taylor, of Adelaide, in acknowledging the receipt of Mr. Mault's report, said he had no doubt, from his experience of what had been done elsewhere, that of Hobart, with its natural facilities, could be made under that system, one of the best-drained cities in the world.

Dr. PERKINS said, in speaking about Hobart, he had never said anything about its healthiness or unhealthiness; he had simply quoted the death rate, and left people to draw their own inferences. If they draw fallacious inferences, it was their fault. He was well aware of the many circumstances that affected the death rate—old age, the proportion of the sexes, and other influences that operated against taking the death rate as a test of the sanitary condition of a town. With regard to what Mr. Morton had said about Edinburgh, he had resided five years in that city, and knew that the water system was almost universal. It certainly had some vile places, one of which was known as the "Forty Twas," but the system adopted by the city was the drainage and water system. It was certainly a fact that typhoid had broken out in the better part of Edinburgh while it was absent from the poorer part, but to argue from that that it was the water system which introduced the typhoid fever was a great error, and arose in the first instance from the opinion of some doctors that typhoid was solely a sewer gas fever instead of being taken in with the drinking water as well. He quoted an extract from Dr. Parkes, an eminent authority on hygiene, who gave the statistics of the decrease in deaths for zymotic diseases on the continent by the institution of underground drainage, and contended that cholera had been abolished by that system. Only last year an Australian town had saved a total of 139 lives by an underground system of drainage. If such a magnificent and successful result followed from the initiation of underground drainage, was it fair to raise such objections as a want of proper flushing or many other absurd and trivial objections against it? He was prepared, as a member of the Board of Health, to adopt what was best under all circumstances, for each particular town. It did not follow because the water system was best for Hobart, that it should therefore be advocated for every other town in the colony. He was prepared to receive impressions from all quarters of the world, and to advocate that which was best for any particular place. The two systems had not been fairly contrasted during the debate. Mr. Woollnough did not consider, when he stated how objectionable he found the waterclosets, that they were usually placed inside a house, where the earth closets were placed outside. When they came to consider the earth system there were all sorts of details to be settled. In speaking of the watercloset system, Mr. Bastow had said "they are contrary to the first principles of sanitary science." But by all principles of sanitary science the water system was the best. Sewerage was something to be carried away as speedily as possible, not something to make money out of. It was because water carried away all this matter at once that it fulfilled the laws and maxims of sanitary science. These were not his own opinions, but the opinions of all authorities on hygienic science. Then sewerage was not a matter of mere human excreta; there were the refuse and slops of the kitchen, the stable, cowshed, and household slops. The only defect in the earth system, which was admirable from some points of view, was that it did not make provision for the disposal of various liquids of an objectionable nature, which, having no provision made for them, were poured down the gutters. Flushing did no good, for the housekeeper poured them down again, and they were left to fester in the sun, and in the end, after polluting the air, find their way to the sea. He could not see how any other system than the water system could be adopted in Hobart, if it was desired to make it a sweet and wholesome city. It was no pleasure to him to say Hobart was not a

sweet and wholesome city, being a native of it and having his home there. He would be proud to find it the best in Australia, so far as its sanitation was concerned. There had been a great deal of criticism of Mr. Mault's scheme, but no alternative system had been submitted that would deal with all the slops. Liverpool could not be compared with Manchester, because the large number of sailors arriving there, brought contagion from all parts of the world ; but the death rate of Liverpool had fallen since the underground system of drainage had been carried out from 31 to 24 per thousand. Still Liverpool, from a sanitary point of view, had not all the advantages. Taking Hastings, a town with 33,000 inhabitants, which had a death rate of 17 per 1,000, they found that the perfect system of underground drainage had been carried directly into the sea there for £53,000, or less than Mr. Mault's estimate. Indeed, he believed if the drainage of Hobart could be accomplished for £100,000 he would not think it too much for such a boon. At Dover, where the death rate was the same as Rochdale, it had been reduced from 27 to 14, and Mr. Edwin Chadwick said if the same system of water closets and drainage carried out at Dover had been carried out at Rochdale the death rate there would have been reduced to 14. These facts went far to prove that with an underground system they were not likely to have all those diseases they heard so much about, but were likely to abolish them altogether. As a member of the Board of Health he desired to see Hobart placed in the position she ought to occupy—the first in a sanitary point of view among all the cities of Australasia.

Mr. MAULT in replying said he desired to approach the subject in the same liberal and open manner as had been adopted throughout the discussion, and though he felt warmly on the subject he hoped that he would not be taken to have any one-sided view of his own case. He thought they were to be guided in considering this question by a consideration of law, and he was sorry to find the Hobart Local Board had, while deciding not to adopt the scheme proposed, substituted one that has a direct infringement of existing laws. They deliberately propose that all the sewerage of the city shall be conveyed to the sea in the open gutters, notwithstanding that in the Police Act any person depositing any objectionable matter or liquid in the streets or gutters was liable to a fine or imprisonment. The main objections against his system were economic ones. Mr. Bastow commenced his paper by saying that if the Government would give £60,000, a system of underground drainage would be preferable. He did not under-estimate questions of cost ; but where danger to the life and health of a large number of people was being considered, the question of cost became secondary. Mr. Bastow, for the purpose of upsetting the estimate made, assumed certain erroneous data. For instance, Mr. Bastow had assumed a depth for the sewers, that had he looked at the plans he would have found would have taken them below the sea level. In support of his estimate he contended that at the prices under the Government works contract now in force, the works could actually be constructed for £40,360, exclusive of the cost of supervision. He had allowed £25,625 for two sizes of pipes, and he found out that at Launceston, where a good deal of that kind of work was being done, and at the price of labour there, these two pipes could be laid down for a little under £10,000. He instanced these cases to show that he had been careful to fully estimate. Nothing had been advanced against him by way of argument to prove that his estimates were wrong. The comparison as to the cost of the work, under the dry system at Manchester, with what it would be in Hobart, was altogether fallacious, owing to the much greater numbers in Manchester. The opponents of his system would furnish no estimate of the cost of carrying out any other. In consequence of this he was obliged to furnish the figures for the other systems as well as his own. Nearly

all his remarks had been addressed to a question which had not been debated at all—the question of conveyance. In the Thames Valley the question was not one of conveyance, but of ultimate disposal to the sewerage. By some speakers they were asked to adopt the pan system because of a few trifling private experiences of private individuals, and to forget that 900,000 houses in London had been fitted with water-closets drained into sewers, causing the death rate to decrease from 28 to something less than 20 per 1,000. Mr. Grant was quite correct in attributing the fever at Croydon to pipes, but it was to water pipes, not drain pipes. The fever was most distinctly traceable to imbibing poisonous water, and Croydon was now one of the most notorious successes of the drainage system. Regarding the water question, he defied anyone to prove that 65 gallons a day was used without the most extravagant waste. He desired to point out that sewer gas was never generated in running sewers, but only in stagnant sewers. The gas never generated where water was running at the rate of 2½ft. per second, and one in 300ft., or one in 250ft., would give that flow. In Hobart it was impossible to get so flat a grade as that except very near the exits. Adelaide was unfavourably situated in this respect, and the people there were put to large expense in consequence. Faults in ventilation had been made, but they had been remedied by ventilating shafts, etc., and those who were strongest against it were now most in favour of the underground system in Adelaide. He had considerable experience in sanitary matters, but he never in all his experience came across such an excellent body of by-lays as those drawn up in Adelaide. In that city when the drainage works were commenced the population was 41,241, and the deaths from preventable diseases amounted to 4·14 per thousand; when while the works in 1885 were completed the population was 43,969,and the deaths from preventable diseases was 1·52 per thousand—a saving of 113 lives. In Hobart, taking the registration area, the population was 28,648 in 1881, and the deaths from preventable disease was 2·06; and in 1885, with a population of 29,987, the death rate from the same causes was 2·53. Hobart should not rest content with being in as favourable a condition in sanitary matters as other cities; it should be above all from its natural position and facilities for becoming such. He did not expect to see his scheme adopted without opposition. He knew there were many points for consideration about which he was desirous of knowing more; but he advocated it as the best that could be adopted for the health of the city.

On the motion of Mr. C. J. Atkins, seconded by Mr. C. H. Grant, a vote of thanks was passd to Mr. Mault for his valuable paper.

OCTOBER, 1886.

The usual monthly evening meeting was held on Monday, October 11, at the Society's rooms, Mr. James Barnard in the chair. There was a good attendance of Fellows, and a number of visitors.

Very Rev. Chas. Leslie Dundas, Dean of St. David's, and Mr. H. B. Bruford, Hobart, were elected Fellows of the Society.

The following donations to the library were announced :—
American Agriculturist, September.
Annals and Magazines of Natural History, vol. 18, No. 104, August.
Athenæum.

Catalogue of Australian Land Shells, by J. C. Cox, M.D. Catalogue of Minerals and Rocks in the Australian Museum, by Gerard Krefft. Exchange list of Land and Marine Shells from Australia and the adjacent islands. By J. C. Cox, M.D.—From J. Brazier, C.M.Z.S.

Geological Magazine, August.

Imperial Federation, August.—From the Editor.

Journal of the Society of Arts, July.

Journal of the Royal Microscopical Society. Ser. II., Vol. VI., Pt. 4, August.

List of the Mollusca in the collection of the British Museum, Pt. II, Olividæ By J. G. Gray.—From J. Brazier, C.M.Z.S.

Monthly notices of the Royal Astronomical Society, Vol. XLVI., No. 8, June.—From the Society.

Nature, July.

"Note on an experiment by Chladni." "On the Bleaching of Iodide of Starch by means of Heat."—By Chas. Tomlinson, F.R.S.

Proceedings of the Queensland Branch of the Geographical Society of Australasia, 1st session, 1885-6. Vol. I.—From the Society.

Prodromus of the Zoology of Victoria, or figures and descriptions of the living species of all classes of the Victorian Indigenous Animals. Decade XII., by Prof. F. McCoy, F.R.S.—From the Society.

Records of the Geological Survey of India, vol. xix., part 3.—From the Society.

Remarks on a new theory of Dew, by Chas. Tomlinson, F.R.S.

Reports on the results of dredging, under the supervision of Alexander Agassiz in the Gulf of Mexico (1877-80), and in the Carribbean Sea (1879-80), by the U.S. Coast survey steamer Blake, xxviii.

Description of 13 species and two genera of Fishes from the Blake collection, by G. Brown Goode, and Tarleton H. Bean, vol. xii., No. 5. From Alexander Agassiz.

Reports of the Mining Registrars for the quarter ended 30th June, 1886.—From the Government.

Société de Geographié, No. 14, 15, 1886.—From the Society.

Statistical Register of the Colony of Victoria for the year 1885, Pt. IV.—"Vital Statistics."—From the Department.

Transactions of the Geological Society of Australasia, Vol. I. pt. (Victoria).—From the Society.

Victorian Naturalist, Vol. III., No. 5, September.—From the Society.

NEW MEMBERS.

The CHAIRMAN stated that the name of Hon. James Smith, M.L.C., would be submitted for election at next meeting. Mr. Smith had received the distinction of being made a member when Sir Henry Lefroy was president, but had some scruples about accepting the position, which had since been removed. He thought it would be a great pleasure on the part of the Fellows to do honour to the discoverer of Mount Bischoff.

PAPERS.

Mr. R. M. JOHNSTON, F.L.S., read a paper, entitled—"Fresh contribution to our knowledge of the Plants of Mesozoic Age in Tasmania." Mr. Johnston, in opening his paper, stated that "certain beds of grey shales have recently been exposed at Lord's Hill, New Town, by Mr. Dorman, builder, who kindly afforded me every facility for their examination. These beds are intimately associated with the beds containing the coal seams at New Town, and as they were full of impressions of plant remains, I spent a considerable time in making collections and in thoroughly examining the numerous forms. The results have far surpassed my utmost expectation, for in the following pages I shall be able to show that about 15 forms of great interest, new to

science, have been added to the list of the Mesozoic plants of this island. The cycadeous and coniferous plants especially are very important, and are fully discussed under the section where they are specifically classed and described. The coniferous genus Baiera is of more than ordinary interest, as I was fortunate in obtaining both the male and female fructification attached to the pedicels of the plants, which are very numerous in these shales, and share with Thinnfeldia odontopteroides, Morris; Alethopteris Australis, Morris; Neuropteris Tasmaniensis, Johnston; Pterophyllum Strahani, Johnston; and Sagenopteris salisburioides, Johnston, in being the most abundant and typical of the numerous forms of plants occurring in great perfection in the shaly beds at the place indicated. The following is a more complete list of the species observed by me at this place, all of which were obtained within the space of a few yards in width and one or two feet in depth. It will be seen that the new discovery forms a very important addition to the already known plants of the period." Mr. Johnston was of opinion that Australian geologists should refuse to adopt the European classification so far as sub-divisions of systems are concerned. He gave several striking reasons for his contention, one of which was from Tasmanian rocks of the Miocene age, where a vegetation consisting of oaks, elms, beeches, alders, laurels, etc., prevails, showing a closer resemblance to the existing vegetation of Europe than is exhibited by the existing vegetation of Tasmania. Proceeding, he urged "With these facts and considerations before us, I cannot but express my strong conviction that it would be unwise to accept the triple subdivision of *Triassic Jurassic* and *Cretaceous* for the Mesozoic rocks of Australia and Tasmania, as such triple subdivision does not in the remotest degree harmonise with -the local facts of either stratigraphy or palæontology. In Tasmania there is no break showing alternation of sea and land throughout the whole series of formation belonging to the Mesozoic period, and typical specific forms persist throughout all the separate groups which from their extent indicate a vast period of time. The great sameness of forms of vegetable life presents a great difficulty in breaking up our scattered formations of this age into geological subdivisions, and I at least am as yet far from prepared to indicate any satisfactory lines whereby the whole series could even be separated into superior and inferior groups. In time, when the distribution of certain forms can be more exactly determined, such a simple method of grouping, having a local significance, may be adopted with advantage; but in the meantime I am convinced that it is only on the broad lines of systems that we can suggest parallels with European and other distant regions." A complete description of 15 new species, with illustrations, accompanied this excellent paper; also a table showing, approximately, the known distribution in time of genera of plants occurring in the Upper Palæozoic and Mesozoic rocks of Australasia.

Mr. E. Swan said the fact that Mr. Johnston had discovered fifteen new species spoke a great deal for his power of research, because the excavations for wells and houses on the other side of the road at Swan's Hill exhibited a similar formation, specimens from which had been submitted to different *savants* here.

Mr. Johnston said that was quite excusable, as those who dealt with the matter before were simply collecting specimens, and he did not know of any local person who had hitherto worked closely at the plants and their classification. They had mostly been satisfied with making a collection for the Museum, and many of the specimens had been collected by unscientific persons, who were naturally attracted by the more beautiful impressions. A very beautiful slab of impressions submitted to him contained only one species, and that was not new. It was only by careful work, frequently among the most insignificant

fragments, where he obtained traces, which led him to hunt till he obtained more perfect specimens, that he had been able to collect what he had submitted. The fragments collected by Dr. Milligan and others had assisted him greatly by causing him to be watchful to discover more perfect representatives of certain plants of which imperfect fragments already existed in the Museum.

The SECRETARY read a paper on "The Tin Ore Deposits of Mount Bischoff, Tasmania," by Baron A. V. Groddeck, which had been translated by Dr. Wolfhagen, and was a continuation of a similar paper read in 1884.

Mr. SPRENT said it appeared that the Baron had received an impression that the Society had doubted the correctness of his determination of the rock referred to. This was not so, for the discussion which had taken place on the previous paper was as to which of the many porphyries the one described by the Baron as topaz belonged. There were a great many porphyries at Bischoff, so it would be advisable to write to the author of the paper and ask if he would kindly send some small fragments of the rock, to be compared with those in the Museum. Neither Mr. Kayser nor Mr. Smith knew exactly which rock it was, and Mr. Kayser thought it had been covered up by some tailings. The rock varied so much that it would take an experienced mineralogist to tell which was the one. If they had only retained type specimens to refer to, the question might be settled, and there was no better school in the world to refer to than Clausthal, and if the Baron was communicated with the point might be settled.

The SECRETARY said he had written to Mr. Thureau, asking him if he would kindly forward to the Museum the microscopical specimens of the rock. With regard to specimens from Mount Bischoff, Mr. Kayser had promised to make a complete collection of the rocks of the Mount Bischoff district, and forward them to the Museum.

Mr. SPRENT said it was a great pity the Museum was not furnished with a better collection of mineralogical specimens of Tasmania. He suggested that Mr. Morton should go through the country next summer and make a collection for the Museum. The surface specimens at Bischoff were getting more difficult to obtain every year, and if they were not secured soon they would not be obtainable at all.

Mr. JOHNSTON agreed with Mr. Sprent that in sending specimens away it was desirable to retain types, and have the specimens numbered, so that it could be seen which were referred to.

Mr. F. ABBOTT read a paper entitled "Notes on a recent case of poisoning by Rhus radicans exhalation at the Botanical Gardens." Mr. Abbott pointed out the habits of the plant, which is indigenous to North America, and described how five men were poisoned, two of which cases were serious ones, while engaged in cutting down the plant and taking it away to be burnt up. He had never known the plant to injure anyone before, and though he was present on the occasion referred to and handled the plant he was not affected by it. The latter fact he could not account for, but he thought the plant was more noxious at certain seasons than at others. Moreover it was well authenticated that it affected some people more than others, and was most injurious to people of a nervous or irritable temperament.

Dr. C. E. BARNARD thought Mr. Abbott had brought a very interesting matter forward with a good deal of botanical information. He was not aware it was the poison in question that had affected these men, or that the tree was here. He had heard of it before at San Francisco; but when he first saw these men similarly affected on the arms and face, he at first inclined to the opinion that it was a case of poison-

ing resulting from tatooing—a practice he believed these men indulged in in their hours of rest. In San Francisco he accidentally heard of some officers of one of Her Majesty's ships who were going to give a party on board their vessel and were anxious to have it decorated. With that end in view they procured the first green boughs they could find, and were pleased to get something so exactly suited to their purpose for decoration. They were considerably surprised, however, when the ladies came on board and refused to enter a place so admirably decorated. Several of the officers themselves who decorated the place were laid up for a long time afterwards. When the men referred to in the paper were brought to him he thought it looked like a case of blood poisoning. He could hardly think it was an emanation from the plants which poisoned, but inclined to the belief that it was that the poisoning proceeded from the milky exudation from the plants when cutting them, which had been smeared on the arms and face. The symptoms described were certainly akin to erysipelas, which in effect it was. It was a very singular plant, and it was interesting to have Mr. Abbott's account of it.

Mr. ABBOTT pointed out that in one case the irritation broke out on the abdomen and over most of the body.

Dr. WOLFHAGEN said he was inclined to the belief that the symptoms described were a kind of eczema, which was similar at first to an attack of erysipelas. The plant had fine hairs,and it might be possible that these hairs caused the irritation and inflammation, and the skin of face and arms being more delicate, was consequently more liable to attack. According to the latest authorities, erysipelas was supposed to be due to a poison germ. The sufferings of these men might be due to the mechanical irritation of the hairs described, or to the presence of the erysipelas germ in the plant. The discovery of the latter hypothesis would be extremely interesting.

Mr. WARD suggested that the poison had emanated from the plant, as it was burning and was an acrid juice distilled from it by heat. If it was due to the juice of the plant the hands would have been affected. Mr. Abbott's immunity might be due to the difference between his diet and the prison fare.

Mr. JOHNSTON said he had examined the plant, and did not find any hairs that would come readily from it.

Dr. BARNARD said a poison had been extracted from the plant known as toxicodendric acid.

The SECRETARY read several cases to show that the plant did not have the same effect on all people, its effect varying in different constitutions.

Mr. J. B. WALKER related a very unpleasant experience he had after culling a common purple creeper, *dolicos pruricus*, which has a quantity of irritant fibres at the ends of the seed vessels. The effect was an intolerable itching for some time, and an excessive thickening of the skin.

Dr. PERKINS said the subject had been almost exhausted. He believed the plant was collected for medicinal purposes at night time, thus proving that it was the emanation from the plant was capable of producing the disease of toxic poisoning. The poison attacks the nervous system, and was similar in symptoms to strychnine. It was a powerful agent, and had been used with more or less effect in paralysis. He quite agreed with Mr. Abbott that its effect would be greater on nervous or irritable people, and attributed Mr. Abbott's escape to his phlegmatic temperament.

Mr. WARD said there were instances of total blindness having been caused by the juice of this plant being rubbed into the eyes.

Mr. ABBOTT, in reply to the theory that it was the action of the fire upon the plant that caused the poison to distil, pointed out that the man who suffered most had not been near the fire, nor did the diet question come in, for two of the men who suffered were men employed in the gardens who were not on low diet.

Dr. PERKINS pointed out the common error of supposing that the upas tree had a deadly exhalation. The deadly nature of the valley in Jarra commonly thought to be caused by the upas tree resulted from carbonic acid gas, which rose from the earth, and nothing lived in that valley, not even the upas tree itself.

Mr. J. R. MCCLYMONT read a paper entitled "History of Australian Geography, II. Tasmania and New Zealand, on the Dauphin and other MS. maps." Mr. McClymont prefaced his paper by a brief account of the first Portuguese voyages to India—those of Vasco de Gama and Cabral—drawn from Mr. Major's "Prince Henry the Navigator." He adduced arguments tending to indicate that the discovery of some part of Australia might have been made by some of Cabral's ships, scattered as they were by a hurricane off the Cape of Good Hope, and quoted a passage from Mercator in support of this possibility.

MICROSCOPE.

Mr. C. J. ATKINS exhibited, by the aid of the miscroscope, some very interesting living specimens of Cyclops, a genus of minute Entomostracous Crustaceans of the order Branchiopoda, having a soft and rather gelatinous body divided into two portions, one consisting of the head and thorax, and the other forming the tail. Under the microscopes the animal was of a very bright colour, sparkling like a gem. They appeared, under an inch objective, very active, and dart about with great rapidity. The species Cyclops are very numerous, inhabiting both the sea and fresh waters. Great interest was taken in the specimens by the members present.

On the motion of Mr. Justin McC. BROWNE, a vote of thanks was unanimously accorded the writers of the papers.

NOVEMBER, 1886.

The monthly meeting of this society (the last of the session of 1886) was held on Monday evening, November 22, when a number of interesting papers were read, and the vice-president delivered his closing address. The vice-president, Mr. James Barnard, presided, and there was a large attendance of Fellows, including the hon. the Premier (Hon. J. W. Agnew, M.D., M.E.C.), Hon. P. O. Fysh, and several ladies.

Messrs. C. P. McCarthy and S. Glassbrook, of England, were introduced as visitors.

Dr. Gray, of New Norfolk, was elected a Fellow of the Society.

The assistant secretary (Mr. A. Morton) laid on the table the usual returns.

List of additions to the library during the month of October :—

Annals and magazines of Natural History, No. CV., Vol. 18.

Annual Report of the Department of Mines, New South Wales.—From the Government.

Bollettino della Società Geografica Italiana. Series II., Vol. XI., Fax. 8, 9.—From the Society.

Boletim da Sociedade de Geographia de Lisbon. 6A serie, No. 1—2. —From the Society.

Bulletin of the American Museum of Natural History. Vol. I., No. 7. July, 1886.—From the Department.

Description and Illustration of Myoporinous Plants of Australia. By Baron F. Von Mueller, K.C.M.G.—From the Government.

Geological Magazine, September, 1886.

Imperial Federation, October 1.—From the Editor.

List of Foreign Correspondents of the Smithsonian Institution, July 1, 1885, by George H. Boehmer.

List of Institutions in the United States receiving Publications of the Smithsonian Institution.—From the Department.

Proceedings of the Royal Society of England. Vols. 38 to 40. Nos. 238 to 244.—From the Society.

Proceedings of the Linnean Society of New South Wales, second series, vol. 1, pt. the third.—From the Society.

Prodromus of the Zoology of Victoria, or figures and descriptions of the living species of all classes of the Victorian Indigenous Animals, Decade XIII, by F. McCoy, F.R.S.—From the Government.

Report of the Meteorology of India in 1884. By. H. Blandford, F.R.C.—From the Department.

Report of the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia, with the reports of the Standing Committee for 1885-6.—From the Department.

Statistics of the Colony of New Zealand for 1885, part III. Trade and Interchange, part IV. Finance, Accumulation, and Production, part V. Law, Crime, and Education.—From the Department.

Transactions of the Seismological Society of Japan. Vol. IX., pts. 1, 2, 1886.—From the Society.

Victorian Naturalist. Vol. 3. Nos. 6. 7.—From the Society.

PAPERS.

MOUNT LYELL AND THE LINDA GOLDFIELDS.

Mr. R. M. JOHNSTON read a very interesting and exhaustive paper on the recent discoveries at Mount Lyell and Mount Owen. The paper dealt with the subject from a geological point of view, and was accompanied by a detailed analysis prepared by Mr. Ward, Government analyst. It also dealt with the theories of gold veins, and their mode of occurrence.

Mr. C. P. SPRENT said that he had not visited the district, but hoped to do so some day. From reading the accounts in the newspapers, Mr. Thureau's report, and also from information from Mr. David Jones, the district surveyor there, he had come to the conclusion that the deposits at Mount Lyell were very similar to the deposits at Mount Bischoff, although the associated minerals varied. He had not the slightest doubt that the description of Mr. Johnston of the formation and origin of the Mount Lyell deposits was correct. Many prospectors had been writing to him from the West Coast about the different iron blows there, and he knew that about half a dozen parties had gone to see some that were not generally known, so that probably more would soon be heard of them. The Government had decided to cut a track from Mount Lyell by Mount Ramsay, which would open up a most interesting country which hitherto he believed had not been traversed by over half a dozen men.

Mr. T. STEPHENS read the following extract from a letter received by him from Professor Liversidge on the gold deposits of Mount Lyell:—"The gold seems to be associated with a micaceous schist (but it is in such a fine powder that it is difficult to determine this), a little quartz, and much oxide of iron, some of which is certainly present as micaceous red hæmatite. Most of the mineral passes through a No. 80 sieve without any crushing being required. On crushing it in an agate mortar, all

portions of the sample readily yielded spangles of gold, easily visible after washing off the powder. It must be very rich; and on boiling it with hydrochloric acid, gold is at once seen in the whitish-coloured residue. If there be the quantity of ore stated, the deposit will certainly rival the Mount Morgan claims in value, provided the sample received be a fair average one." He thought that they yet wanted some more detailed geographical examination of the country before they could form conclusions as to the formations, and the modes in which the deposits had occurred. He hoped that during next summer there would be much added to their present stock of knowledge, and that it would form a subject of discussion on future occasions.

Dr. AGNEW asked how far the iron blow extended.

Mr. JOHNSTON said that it had been traced about one mile and a-half, but that its downward direction had only been superficially tested.

A NEW EUCALYPT.

A paper was read by the assistant secretary, in the absence of the author, Mr. T. B. Moore, entitled, "Notes on the Discovery of a New Eucalypt," which he found during a recent exploration for the Government in the country situated between the townships of New Norfolk and Victoria, at an altitude of 2,000ft. above the sea level. Mr. Moore stated in his paper that he found a splendid forest of this gum tree extending in a narrow strip of three miles along the southern side of the range. Many of the trees were over 200ft. in height, and some were branchless for over 100ft. He pointed out the quality of the wood as being of a light red colour, extremely hard and surprisingly heavy, and he was of opinion that it would be found to equal the far-famed wood known as the blue gum. He strongly recommended that the trees should be brought under conservation by the Government without delay.

The paper was accompanied by a few concluding notes by Baron von Mueller.

MOLLUSCA.

A very comprehensive paper entitled "The Trochidæ and other Genera of Mollusca from Tasmania, with synonyms," being the first of a series of papers promised by Mr. J. Brazier, F.L.S., was read by Mr. A. Morton, assistant-secretary.

TASMANIAN BIRDS.

Colonel LEGGE laid on the table the second part of his forthcoming catalogue of Tasmanian Birds, Psittaci (Parrots), and the Picariadiæ, and a systematic list of the birds of the country, also notes on the genus Ephthianura. He said that he had divided the birds into twelve orders, or families, giving the scientific and English names.

Mr. A. MORTON thought that this catalogue would be extremely valuable to the society, and the public generally. He trusted that the society would not only publish the catalogue, but also the Government, so that it could be sent to the different schools. It was surprising the number of young people who visited the museum, and were working up this subject, labouring under the disadvantage of not having books to assist them. He hoped the society would ask the Government to publish this work at the public expense.

Mr. A. MAULT trusted that the Government wouldtake into consideration the suggestion of the Curator, and have this interesting catalogue printed for distribution among the schools. Nothing would tend to give children a greater knowledge and love of nature around them, and its study would form a most valuable part of education that would add a great deal to their pleasure both in and out of school.

Nothing would tend so much to induce people in the town to go more in the country than a study of natural history.

Dr. AGNEW said it was rather dangerous to make promises, but he thought it would be well to make application to the Government, and he thought that a very strong plea could be urged in favour of the application, inasmuch as its distribution among the schools would be very valuable.

A NEW FOSSIL.

Mr. T. STEPHENS submitted a photograph of a new fossil from the excavations for the dock at Biloela, near Sydney. Identified by Professor Stephens, of the Sydney University, as one of the throat plates of a large Saurian, a representative of a fossil order widely dispersed through the Northern Hemisphere, but not hitherto recorded in the Australian colonies, except as to a specimen of the genus Bothriceps described by Huxley, from a skull found somewhere in Australia. The photograph showed the natural size of the fossil, which was not quite perfect, but Professor Stephens had no hesitation in describing it as belonging to an individual of the genus Mastodonsaurus, of the order Labyrinthodona, associated in the Triassic series with the Ceratodus, found living in Australia. The discovery was too important to allow of the specimen being kept at home, and it had been sent to England for examination by Professors Owen and Huxley.

ADDRESS.

Mr. JAMES BARNARD, Vice-President, then delivered the closing address as follows:—"It has become my privilege to again review the proceedings of another year of active work performed by the Royal Society of Tasmania; and it is cheering to know that there has been an increasing interest taken by its fellows in the discussion of the various papers submitted at the evening meetings. Perhaps during no previous session has there been such a number and variety of subjects brought forward; and although some of them may probably be considered as scarcely within the strict domain of science, yet it will be at once allowed that they possess no inconsiderable value of their own, as well as being calculated to exercise an important bearing upon the well-being of society. Geology, as usual, has come well to the front in the various excellent papers that have been presented. The first to be noticed is the comprehensive paper by Professor Hutton, of New Zealand, on the geology of the New Zealand Alps, and full of interest from showing the relation of its rocks to those of Tasmania. Mr. R. M. Johnston, F.L.S., follows with an account of the geology of Bruny Island, and embodies an interesting discovery of the position the Adventure Bay coal occupies in the coal measures as shown by its characteristic plants. Mr. Johnston, in another paper, dilates upon the Tertiary marine beds at Table Cape, as exemplified by their plant remains, and submits a new catalogue of these tertiary fossils, including some 380 species. In addition to a paper referring to the coal discovery at Longford, illustrated by diagrams, the same geologist, later on, relates some fresh discoveries of fossil plants of the Mesozoic age in Tasmania as disclosed in the coal seams at New Town. Mr. Johnston, also has given a timely and interesting sketch of the geology of King River in the Mount Lyell district, with explanatory diagrams; and in conjunction with this subject has discussed the various theories of the production of gold. Mr. Johnston, on behalf of Mr. S. H. Wintle, F.L.S., of Victoria, read some notes on certain fossil crabs taken from the deep dredgings of the Yarra River and excavation of the Coode canal, Victoria. We are indebted to Baron A. V. Groddeck, our recently elected corresponding member, for the continuation of his valuable paper on the tin deposits of Mount

Bischoff. Some interesting remarks by Mr. T. Stephens, F.G.S., on the genuineness of the specimens sent to, and described by, the Baron, will be found in the proceedings. Mr. Stephens also exhibited and described a photograph, the natural size, of a bone of the Labyrinthodon order, Mastodonsaurus robustus, which he had received from Professor W. Stephens, of the Sydney University.

In Ichthyology Mr. Saville-Kent, F.L.S., F.Z.S., has contributed two papers, one describing a suspected hybrid trumpeter and other rare fish found in Tasmanian waters ; the other, a note upon the occurrence of the Sydney crawfish on the coast of Tasmania. Mr. Kent has also communicated some interesting notes on oyster culture, which he exemplified by specimens grown on split palings covered with cement, showing the progress made towards the success of this grand experiment.

In Conchology, Professor Tate, F.G.S., F.L.S., contributes a critical paper in which he discriminates certain Australian Pectens, hitherto confounded with those from New Zealand. To our corresponding member, Mr. J. Brazier, F.L.S., of the Australian Museum, Sydney, we are indebted for a very comprehensive paper on the Trochidæ and other genera of Mollusca from Tasmania, with their synonyms, being the first of a series of papers on the Molluscs of this colony.

In Ornithology, Colonel Legge has read two papers towards his contemplated Catalogue of the Birds of Tasmania, together with a systematic index ; dividing the list into twelve orders or families, giving both their classical and English names. This work, when completed, cannot but be greatly appreciated.

In Botany, Mr. R.A. Bastow has dealt exhaustively with the attractive subject of the "Mosses of Tasmania," dwelling upon their collection, observation, and identification ; and the paper is profusely illustrated with lithographs. Mr. Abbott, of the Botanical Gardens, has described a remarkable case of poisoning by exhalations from the plant *Rhus radicans*, which elicited an interesting discussion. Mr. T. B. Moore has given an account of the discovery of a new species of Eucalyptus, discovered at an altitude of 2,000 feet above the sea level, to which has been added some notes by our highly distinguished honorary member, Baron Von Müeller.

Astronomy has been represented by communications from Mr. A. Biggs, on certain phenomena of Jupiter ; and his hypothesis on the question, "Is Jupiter self-luminous?" Mr. McCance, F.R.A.S., read some notes on sun spots, accompanied by photographs.

Natural geometry, illustrated by diagrams, was the title of an admirable paper by Mr. A. Mault, C.E., having for its object the true method of teaching mathematics by the use of visible concrete demonstrations instead of abstract ones. So clear and convincing did this mode appear that it received the unqualified approval of the Fellows present, who at once recognised its value in education, and the soundness of the principle in teaching the concrete first and the abstract afterwards ; and a general desire was expressed that steps would be taken by the Director of Education to have this method of instruction introduced into the State schools.

Historical Geography.—A valuable presentation of photo-lithographs of four early charts of Australia of the 16th century having been made to the Royal Society by the trustees of the Melbourne Public Library. Mr. J. R. McClymont, M.A., has read two very able papers towards their elucidation. These maps tend to show the probability of the discovery of some portions of Australia by the Portuguese ; and the subject is invested with a consideraole amount of historical interest.

Antarctic Exploration.—As the result of a communication from the Premier of Victoria to the Government, intimating the existence of an intention to despatch an expedition to the Antarctic regions in the interests of science and commerce, and inviting the co-operation of Tasmania towards the accomplishment of that grand project, the Hon. the Premier expressed the desire that the correspondence should be brought under the consideration of the Fellows of the Royal Society; and, accordingly, a most interesting paper was read by Mr. C. P. Sprent, pointing out, after an exhaustive review of what had been done in the past, the benefits to be expected from the expedition, and giving good reasons why Tasmania should take her share in promoting this honourable enterprise by contributing towards its cost, and, it may be, participating in the future glory of its success. After discussion the following resolution was unanimously adopted, viz.:—"That, in the opinion of this Society, it is desirable in the interests of science and commerce that the exploration of the Antarctic regions should be continued, and that Tasmania should co-operate with the other Australian colonies in the despatch of an expedition for that purpose; and that the council communicate this resolution to the Premier." It is to be hoped that all the Australasian colonies will combine with the Home Government in the prosecution of this truly national undertaking.

Drainage and Sewerage of Hobart.—Perhaps one of the most important subjects of social interest brought before the Royal Society during the session has been that now referred to, which led to a prolonged discussion that was extended to a second evening specially assigned for that purpose. The author of the paper was Mr. A. Mault, C.E., and embodied a long and carefully prepared report to the Central Board of Health, supported by diagrams with elaborate calculations and statistics. Mr. Mault advocated his scheme of water drainage with conspicuous ability, and which received the support of many of the Fellows. The dry earth system, on the other hand, had its able champions, likewise armed with columns of statistics in its favour. Of course there is no practical result to place on record, as it would have been out of harmony with the nsual procedure of the Royal Society to have taken a vote upon the rival schemes, its sole object being to draw further attention to the matter by diffusing information.

Among the miscellaneous items of communication may be mentioned a letter from Rev. H. R. Atkinson on snakes; and a paper on the *Peronospera infestans*, or potato disease, by Mr. Bastow.

As usual, there have been exhibits with the microscope through the courtesy of Mr. C. J. Atkins and Mr. Bastow.

It only remains now to mention that 12 Fellows have been elected, and three have resigned, with a loss of two by death; seven have been added to the roll of Corresponding Members.

Again we have a debt of gratitude to acknowledge to *The Mercury* for its copious and prompt, as well as accurate, reports of the proceedings of the society at its evening meetings.

In conclusion, I take leave to congratulate the Royal Society upon the return to Tasmania of its learned Vice-President, Sir Lambert Dobson; and to express the hope that now in his exalted position as Administrator of the Government His Excellency will avail himself of his position as president of the Royal Society to preside at its evening meetings during the ensuing Session. (Cheers).

The Hon. P. O. Fysh said it might be frequently asked of what use was the Royal Society of Tasmania, and he was glad that that question could be so well answered by the closing address which the vice-president had now read. It was well that year by year institutions like this, which

pursued its unobtrusive action from month to month, should place on record some account of its proceedings. In the paper now read they would have a record published of what the society had been doing during the past year, which let those outside know what they had done. Sitting round this table the language of the rocks, sea, and air was made familiar to them. He congratulated the Society on the good work done, and was sure that the public would not look with a grudge upon the small contribution made towards the Society. He proposed a vote of thanks to the chairman for his address.

The motion was carried by acclamation.

The CHAIRMAN briefly replied, and moved a vote of thanks to those who had read papers that evening.

Mr. JUSTIN BROWNE seconded, and the motion was cordially passed.

This concluded the business.

DECEMBER, 1886.

List of additions to the Library of the Royal Society during the month of December 1886 :—

Annals and Magazine of Natural History, October and November 1886.

Annales de la Société Royale Malacologique de Belgique, Tome XVIII, Troisême Seri, Tome III, Annèe 1883. From the Society.

Annual report of the Secretary of Mines and Water Supply, Victoria, to the Hon. J. L. Dow, M.P. On the Working of the Regulation and Inspection of Mines and Mining Machinery Act during the year 1885. From the Department.

Australian Statistics for the year 1885, with a report by the Government Statist of Victoria. From the Department.

Boletim da Sociedade de Geographia de Lisboa, 6A. Serie, Nos. 3, 4. From the Society.

Bollettino della Sociéta Geographica Italiana, Ser. IV, Vol. XI, October 1886. From the Society.

Bulletin du Musée Royal D'Histoire Naturelle de Belgique, Tome IV, No. 3. From the Society.

Descriptive Catalogue of a Collection of the Economic Minerals of Canada, by the Geological Corps, by A. R. C. Selwyn, C.M.G. From the Department.

Den Norske Nordhavs—Expedition 1876-8, XV., Zoologi, Crustacea, by G. O. Sars. From the Society.

Edinburgh Astronomical Observations, vol. XV., 1877-86. Star Cat. 4th, 24th, R.A. From the Department.

Geological Magazine, October and November.

Journal of the Society of Arts, current Nos.

Manual of the New Zealand Coleoptera, by Captain Thomas Broun, parts 3 and 4. From James Hector, M.D., etc.

Observations of the International Polar Expedition, 1882-3, Fort Rae. From the Department.

Proceedings of the Philosophical Society of Glasgow, vol. 17, 1885-6. From the Society.

Procès—Verbaux des Séances de la Société Royale Malacologique de Belgique, Tome XIII., Annèe 1884. From the Society.

Quarterly weather report of the Meteorological Office (new series). Pt. IV. October, December, 1877. From the Department.

Records of the Geological Survey of India. Vol. XIX., pt. 4, 1886. From the Department.

Report on the Administration of the Meteorological Department of the Government of India in 1885-6. From the Department.

Report on the Telegraphic Determination of Australian Longtitudes *via* Singapore, Banjoewangie, and Port Darwin. From the Government Astronomer, Victoria.

Reports of the Mining Registrars for the quarter ending 30th September, 1886. The Goldfields of Victoria. From the Department.

Results of Meteorological Observations, by J. Tebutt, New South Wales, 1882-3-4-5. From the Author.

Statistics of the Colony of New Zealand during the year 1885. From the Department.

Statistical Register of the Colony of Victoria for the year 1885. Pt. 5. Interchange. From the Department.

Twentieth and twenty-first annual report on the Colonial Museum and Laboratory, together with a list of donations and deposits during 1884-5, and the sixteenth and seventeenth annual report on the Colonial Botanic Gardens, 1884-5, of New Zealand. From the Department.

Vehrandlungen der Gesellschaft Fûr Erdkunde Zu Berlin, Band VIII., Nos. 4, 8, and 9. From the Department.

Walch's Tasmanian Almanac, 1887.

A collection of ten water colors and sketches of Tasmanian scenery by the late J. S. Prout. Presented by the Hon. Wm. Robertson, M.L.C., of Victoria.

PRINTED AT "THE MERCURY" OFFICE, MACQUARIE-STREET.

PAPERS.

ON THE GEOLOGY OF THE NEW ZEALAND ALPS.

By Captain F. W. Hutton, Corr. M.R.S., of Tasmania.

[*Read April 13th*, 1886.]

The New Zealand Alps form a narrow range of mountains dividing the plains of Canterbury from those of Westland, and attain in Mount Cook an elevation of 12,349 feet. Both to the north and to the south they widen out into several subordinate ranges with peaks from 6,000 to nearly 10,000 feet in height. The principal snowfields and glaciers occur in the central portion between the sources of the River Rakaia and those of the Waitaki; but small glaciers are found as far north as the head of the Waimakariri, near the West Coast Road, and as far south as Lake Wakatipu and Milford Sound. The largest glacier is the Tasman, which lies on the eastern side of the range just north of Mount Cook and which, according to the survey of Dr. von Lendenfeld, is rather more than twenty miles in length by nearly two in breadth; its terminal face being 2,450 feet above the sea. On the western side of the range the glaciers are smaller, but descend much lower; the Francis Joseph glacier reaching to 705 feet above the sea. This is owing partly to the greater snowfall, and partly to the steeper slope on that side of the mountains.

Nearly the whole of the Alps are composed of much disturbed sedimentary rocks, principally sandstones, mudstones, and greywackes. The main anticlinal, or true tectonic axis, runs in a south-westerly direction from Tasman's Bay to Otago, where it curves round to the south-east, and reaches the sea near Dunedin. The central parts of this anticlinal are composed of Schists of different kinds. The tectonic axis, however, nowhere coincides with the orographic axis of the range, but lies along its western base in Westland, where the whole of the western portion of the elevated *massif* has been removed by denudation, so that the main ridge of the Alps is carved out of the south-easterly face of the anticlinal curve. To the north and to south of the Alps proper, both wings of the anticlinal remain. West of this main anticlinal a synclinal runs through the provinces of Nelson and through Southland, lying parallel with the anticlinal; but on the eastern side the rocks are more irregular, there being several synclinals and anticlinals

running more or less at right angles to the main anticlinal. The south-western portion of the mountains in Otago is separated geologically from the rest by a fault running through Lake Te Anau in a north and south direction, with its upthrow to the west.

Four different rock systems take part in building up these mountains. The first is the MANAPOURI SYSTEM * composed of Gneiss and Schists of Archæan age. It occupies the south-western portion of Otago, which has been thrown up by the fault and appears again in places along the main anticlinal axis through Westland and Nelson to Tasman's Bay. The second is the TAKAKA SYSTEM, which is largely developed on both sides of the main anticlinal in Otago, extends through Westland and Nelson at the western base of the Alps and is found on the eastern side along the secondary anticlinals in Nelson and South Canterbury. The age of this system is probably Ordovician and Silurian and partly perhaps Devonian. It is composed of Schistose rocks, which, in Nelson, get slaty, and contain Graptolites, while in Otago they are quite crystalline and foliated. Whether these Schists of Otago (Wanaka System) are truly the equivalents of the more slaty and calcareous rocks in Nelson (Takaka System) or whether they form an underlying system has not yet been proved. The third is the MAITAI SYSTEM, which forms the principal parts of the mountains in East Nelson, Marlborough, and Canterbury, and occupies the synclinal in West Nelson. Its age appears to be Carboniferous. The rocks are never Schistose, but often include basic eruptive rocks, such as Diabase and Serpentine, and more rarely, as at Croixelles Harbour, near Nelson, acidic Felsites. The fourth is the HOKANUI SYSTEM, a littoral formation 20,000 to 25,000 feet thick with plant remains all through it. In age it probably covers the Triassic and part of the Jurassic periods. It occurs along the synclinal in Southland, as well as in those of East Nelson and Canterbury, but it is not found in Westland nor in Western Nelson. †

Exposures of granite, belonging probably to the Maitai System, occur in Preservation Inlet on the south-west coast of Otago, and in Westland and Nelson, chiefly along the main anticlinal axis.

The next rock system is of cretaceous, probably upper cretaceous, age, and is known as the WAIPARA SYSTEM. Along

*Quar. Jour. Geol. Soc., Vol. 41, p. 194.

† In the Quar. Jour. Geol. Soc. of London, Vol. 32, p. 54, Dr. Hector gives a section from the Alps to Brighton, on the West Coast, in which this system (marked p.) is shown. But this section appears to be quite a hypothetical one, and intended to explain how the rocks would occur if they were present; for it shews other rocks (k) with "Saurian bones, Ammonites, &c.," although none have ever been found on the West Coast.

the eastern base of the main range it lies quite unconformably on the Hokanui and older rocks, and, according to Dr. Hector and Dr. von Haast, it is also found in a similar position on the West Coast; thus lying at a low level almost on the main anticlinal axis. The Waipara System has itself been much disturbed in Nelson and in Otago, and is everywhere denuded and overlain unconformably by beds of the Oamaru System (Oligocene) and Pareora System (Miocene). Outliers of these cretaceous and tertiary rocks are found far up the Alpine Valleys, reaching a height of 3,000—4,000 feet above the sea, but they do not take part in the folds of the older rocks. Volcanic rocks, chiefly acidic, belonging to the Waipara System, lie along the eastern flank of the mountains in Canterbury from Mount Somers to the Malvern Hills, and later volcanic outbursts took place in the Oligocene and Miocene periods. In the South Island volcanic action appears to have become extinct in the Miocene; the focus of energy changing to the North Island, where it has not yet quite died out.

The probable geological history of the New Zealand Alps is as follows:—The volcanic outbursts which took place during the deposition of the Maitai System, and which we now recognise in the row of granite hills along the centre of the main anticline in Westland and Nelson, as well as in the greenstone ash beds associated with the sandstones and mudstones of the system, may perhaps be taken as the first step towards the formation of the New Zealand Alps. This must have been followed, or accompanied, by elevation and sufficient denudation to lay bare the granitic roots of the volcanoes. A range of mountains must have been formed lying to the west of New Zealand. Their height must have been immense, rivalling probably the Himalaya; for, during the subsequent deposition of the Hokanui System, a subsidence of more than 20,000 feet took place, and yet land must always have been in the neighbourhood, for plant remains are found throughout the system. At the close of the Hokanui period lateral compression, accompanied by upheaval, took place along a line to the east of the earlier chain, and the main outlines of the New Zealand Alps were formed. It was then that New Zealand was separated from Tasmania, and the two have never been connected since. A long period of subaërial denudation succeeded, during which the greater part of the west wing of the main anticlinal was removed, and most of the present river valleys were formed. When this elevation was at its height, volcanic eruptions broke out along the eastern (and perhaps western) side. Depression followed, and the Waipara System was deposited round the coasts. Again, a third elevation took place, accompanied by

folding of the rocks in Otago, in Nelson, and in Malborough, but not in Canterbury. Since then three depressions and two elevations have taken place, during which the greater part of the cretaceous and tertiary rocks were removed by denudation. A third elevation is going on at present.

No one who, after visiting the Alps of Switzerland, should explore the Alps of New Zealand could, I think, fail to notice two remarkable points of difference between these mountain regions. The first is that mountains, with sharp serrated summits, which are the exception in Switzerland, are the rule in New Zealand. The second is that waterfalls are rare in New Zealand in comparison with Switzerland, although the mountains of New Zealand are quite as rough and as rugged as the Alps of Europe. Also, the passes in New Zealand are lower, the valleys are much more terraced, and the mountains are generally much more covered with loose *debris*, than any part of the Swiss Alps. The explanation of these differences lies in the fact that the New Zealand Alps are far older than those of Switzerland. They have been constantly exposed to the action of rain and wind ever since the Jurassic period, and most of the larger valleys had been cut down nearly to their present depth before the Oligocene ; a time when the European Alps and the Himalaya were only just rising above the sea.

CONTRIBUTION TO THE PALÆONTOLOGY OF THE UPPER PALÆOZOIC ROCKS OF TASMANIA.

By Robt. M. Johnston, F.L.S.

[*Read April* 13, 1886.]

During many years of observation among the Upper Palæozoic rocks of Tasmania I have made large collections of fossils in different parts of the island. Among these I have identified many forms, already described by Morris, M'Coy, Dana, de Koninck, and other authors, as occurring in a similar formation in New South Wales. There is a considerable number of important fossils which I believe to be new to science, and, as it is very desirable for purposes of reference and classification that these fossils should be described, I have ventured to submit a list of the fossils known to me as occurring in Tasmanian rocks, together with provisional descriptions of the species deemed by me to be new to science. I have long studied the variability of the various fossil forms

(especially the genera Pachydomus and Notomya), and hope that these notes and descriptions will be an aid to others who have not had equal local advantages in frequently observing such forms in the field.

LIST OF UPPER PALAEOZOIC MARINE FOSSILS KNOWN TO OCCUR IN TASMANIAN ROCKS.

		Localities.
Class ACTINOZOA.		
Favosites ovata.	*Lonsdale.*	Hobart, Porter's Hill, One-Tree Point, Bruny, Maria Island, Ross.
Stenopora crinita.	*Lonsdale.*	Hobart, Maria Island, Ross, Fingal, Prosser's Plains, Variety Bay.
„ Tasmaniensis.	*Lonsdale.*	Common E.T.
Class CRUSTACEA.		
Cythere Tasmanica.	*R.M.Johnston.*	Porter's Hill Beds, Hobart.
Class POLYZOA.		
Fenestella internata.	*Lonsdale.*	Very common E.T.
„ plebeia.	*M'Coy.*	Ditto
Protoretepora ampla.	*Lonsdale.*	Ditto
Class BRACHIOPODA.		
Leptæna.		Huon Road, Porter's Hill.
Orthis Michelini.	*L'Eveillé.*	
Orthotetes crenistria.	*Phillips.*	Huon Road. (?)
Productus brachythyærus.	*G. Sowerby.*	River Styx, Bellerive.
„ Clarkei.	*R. Etheridge.*	Porter's Hill, Proctor's Road, Hobart.
„ cora.	*D'Orbigny.*	
„ Murchisonianus.	*de Koninck.*	
„ pustulosus.	*Phillips.*	Hobart.
„ scabriculus.	*Martin.*	Hall's Quarry, Hobart.
„ subquadratus.	*Morris.*	Mounts Dromedary and Wellington.
„ undatus.	*De-france*	Allan River.
Rhynchonella inversa.	*de Koninck.*	Bellerive, River Styx, King River.
Spirifera Chee-Hiel	*de Koninck.*	
„ convoluta	*Phillips.*	Common E.T.
„ crassicostata.	*Jukes (M.S.)*	Point Puer, Spring Vale
„ Darwinii.	*Morris.*	Common E.T.
„ duodecimocostata.	*M'Coy.*	Ditto
„ crebristria.	*Morris.*	Ilfracombe, Bellerive.
„ glabra.	*Martin.*	Bellerive, River Styx, Ross, Huon Road, Porter's Hill, etc.
„ bisulcata	*J. Sowerby*	Prosser's Plains ?
„ lata.	*M'Coy.*	Huon Road.
„ oviformis.	*M'Coy.*	Bellerive.
„ Stokesii.	*König.*	Eagle Hawk Neck, Mt. Dromedary.

„ Strzeleckii.	*de Koninck.*	Common E.T.
„ Tasmaniensis.	*Morris.*	Ditto
„ vespertilio.	*G. Sowerby.*	Ditto
Strophalosia Jukesii.	*R. Etheridge, jun.*	Proctor's Road, Porter's Hill.
„ productoides.	*Murchison.*	Porter's Hill.
Strophomena rhomboidalis.	*Wahlenberg.*	Ditto
Terebratula sacculus.	*Martin.*	Common E.T.
„ sacculus, var. hastata.	*I. de C. Low.*	Ditto

Class Pelecypoda.

Allorisma (?) curvatum.	*Morris.*	Maria Island, Porter's Hill.
Arca costellata.	*M'Coy.*	Porter's Hill.
„ interrupta.	*de Koninck.*	Ditto
„ subarguta.	*de Koninck.*	Ditto
Astartila cyprina.	*Dana.*	Maria Island, Porter's Hill.
„ cytherea.	*Dana.*	Bellerive.
„ Robertsii.	*R.M. Johnston.*	New Town Falls.
„ polita.	*Dana.*	Ilfracombe.
Avicula decipiens.	*de Koninck.*	Porter's Hill, Bridgewater.
„ Hardyii.	*de Koninck.*	Porter's Hill, Mersey.
„ Tasmanica.	*R.M. Johnston.*	Porter's Hill, Mersey.
Aviculopecten elongatus.	*M'Coy.*	Ditto
„ Fittoni.	*Morris.*	Common E.T.
„ Hardyii.	*de Koninck.*	Porter's Hill.
„ Illawarensis.	*Morris.*	Common E.T.
„ limaeformis.	*Morris.*	Ditto
„ profundus.	*de Koninck.*	Porter's Hill.
„ ptychotis.	*M'Coy.*	Ditto
„ squamuliferus.	*Morris.*	Common E.T.
„ Tasmaniensis.	*M'Coy (M.S.)*	New Norfolk.
„ tessellatus.	*Phillips.*	Porter's Hill.
, consimilis.	*M'Coy.*	Ditto
„ subquinquelineatus.	*M'Coy.*	Ditto
„ lenisulcus.	*J. D. Dana.*	Bridgewater. (?)
„ Sprentii.	*R.M. Johnston.*	Porter's Hill, Hobart.
„ Diemenensis.	*R.M. Johnston.*	Maria Island.
„ Hobartensis.	*R.M. Johnston.*	Porter's Hill, Hobart.
Streblopteria Mortonii.	*R.M. Johnston.*	Shot Tower, Hobart.
Cardinia (?) costata.	*Dana.*	Bridgewater.
Cardiomorpha gryphoides.	*de Koninck.*	Mersey.
„ (?) minuta.	*R.M. Johnston.*	Prosser's Plains.
Edmondia striato-costata.	*M'Coy.*	Porter's Hill.
„ (?) dubia.	*R.M. Johnston.*	River Styx.
Eurydesma cordata.	*Morris.*	Maria Island, Porter's Hill.
„ sacculus.	*M'Coy.*	Porter's Hill.

Inoceramus elegantula.	*R.M.Johnston.*	Ditto
Lithodomus Gouldii.	*R.M.Johnston.*	Bridgewater.
Modiomorpha ornatissima.	*R.M.Johnston.*	Shot Tower.
Notomya Gouldii.	*R.M.Johnston.*	Maria Island, Bridgewater.
„ trigonalis.	*R.M.Johnston.*	Western Tier.
„ Beddomei.	*R.M.Johnston.*	Bridgewater.
Pachydomus carinatus.	*Morris.*	Port Arthur.
„ gigas.	*M'Coy.*	Maria Island.
„ globosus.	*I. de. C. Low.*	Maria Island, Mounts Dromedary and Wellington.
„ Koninckı	*R.M.Johnston.*	Common E.T.
„ Hobartensis.	*R.M.Johnston.*	Ditto
„ pusillus.	*M'Coy.*	Bellerive, Porter's Hill.
Pleurophorus Morrisii.	*de Koninck*	Tasmania. (?)
„ quinque-costatus.	*R.M.Johnston.*	Bridgewater.
Pterinea macroptera.	*Morris.*	Common E.T.
Pteronites latus	*M'Coy.*	Ditto
Sanguinolites Etheridgei.	*de Koninck.*	Ditto
„ undulatus.	*Dana.*	Ditto
Scaldia (?) depressa.	*de Koninck.*	Porter's Hill. (?)
„ lamellifera.	*de Koninck.*	Ditto (?)
Tellinomya Etheridgei.	*R.M.Johnston.*	River Styx, Porter's Hill.
Class GASTEROPODA.		
Capulus sp.		Porter's Hill.
Euomphalus catillus.	*Martin.*	Common E.T.
PleurotomariaMorrisiana.	*M'Coy.*	Ditto.
„ Woodsii.	*R.M.Johnston.*	Mersey, Porter's Hill.
Platyschisma ocula.	*I. de C. Low.*	Common E.T.
„ rotundata.	*Morris.*	Ditto
Class PTEROPODA.		
Conularia inornata.	*Dana.*	Mersey. (?)
„ lævigata.	*Morris.*	River Styx, Porter's Hill.
„ tenuistriata.	*M'Coy.*	Bridgewater. (?)
„ Derwentensis.	*R.M.Johnston.*	Ditto.
Theca lanceolata.	*Morris.*	Porter's Hill.
Class CEPHALOPODA.		
Cameroceras Phillipsii.	*de Koninck.*	Shot Tower.
Goniatites micromphalus.	*Morris.*	River Styx.
„ strictus.	*Dana.*	Ditto.
Orthoceras sp.		Mersey.

NOTE. — The references E.T. signify the marine mudstones, limestones, and sandstones (*Up. Pal.*) throughout the eastern half of Tasmania. The localities are too numerous to mention in detail.

CYTHERE TASMANICA (NOV. sp.)

Shell minute, slightly compressed, oblong-ovate, surface smooth ; there is a shallow depression near the middle. Length, not exceeding ·5 or ·75 millimetre.

This little ostracod occurs in myriads in the Porter's Hill sandstones associated with *Spirifera Darwinii*, *Conularia laevigata*, and other well-known fossils of the Upper Marine Beds. (Up. Pal.)

Family ASTARTIDÆ. *Genus* ASTARTILA. (Dana.)

Shell elongately sub-triangular, inequilateral, slightly inflated, moderately thick at the beaks, and near the margins ; thin in the middle ; on the surface concentrically striated or lamellated ; ligament external, very long ; muscular impression rather large ; the anterior close to the hinge, and with a small superimposed impression ; pallial line entire, hinge unknown. (Tryon.)

ASTARTILA ROBERTSII. (NOV. sp.)

Shell small, elongately oval, somewhat trigonal and equilateral, nearly a third longer than broad ; beaks prominent, recurved, and approximate, central ; posterior, margin arched ; anterior slope deeply concave about the middle ; valves regularly convex, rather compressed anteriorly ; posterior and anterior muscular impression vertically oval, well-defined on cast ; ventral margin gently curved ; surface ornamentation unknown.

Length, 31 millimetres ; height, 22 mil.; thickness, 16 mil.
Upper Paælozoic sandstones, New Town Falls.

This form approaches most closely to *Pachydomus politus*, J. D. Dana, but differs in being less tumid, in having the umboes more central, and in its greater comparative length ; *P. politus* being only about one-eighth longer than broad.

Family AVICULIDÆ. *Genus* AVICULA (Klein) Lamarck.

Shell obliquely oval, very inequivalve, eared ; the posterior ear produced wing-like ; right valve with a byssal sinus beneath the anterior ear ; cartillage-pit single, oblique ; hinge line with one or two small cardinal teeth, and an elongated posterior tooth, often obsolete ; posterior muscular impression (adductor and pedal) large, subcentral ; anterior (pedal scar) small, umbonal. (Tryon.)

AVICULA TASMANICA. (NOV. sp.)

Shell small, obliquely spathulate ; bilobed coarsely striate, concentrically ; hinge line scarcely as long as shell ; anterior lobe small, umbonal ; posterior ridge rounded and well-defined ; there is a shallow wedge-shaped trough between ridge and hinge-line, the margin of which is somewhat concave ;

posterior ventral margin, rounded, gradually curved towards small oblique posterior lobe.

Length, 11 millimetres ; height, 14 mil.

Common Upper Marine Beds (Upper Pal.), Mersey.

Family PECTINIDÆ. *Genus* AVICULOPECTEN. (McCoy.)

Shell inequivalve, suborbicular, eared ; hinge-areas flat, with several long narrow cartillage furrows, slightly oblique on each side of the umbones ; right valve with a deep and narrow byssal sinus beneath the anterior ear ; adductor impression large, simple, sub-central ; pedal scar small and deep beneath the umbo. (Tryon.)

AVICULOPECTEN DIEMENENSIS. (NOV. SP.)

Shell large, truncate-orbicular depressedly, convex ; ears unequal, the posterior one of moderate size, obliquely triangular, somewhat concave ; the anterior one large, subovate, flattened or slightly convex, separated at the margin from the body by a deep and acutely rounded sinus ; surface of both ears and body of shell marked with numerous, rather sharp concentric lines of growth, between which there are numerous microscopic wavy concentric striae ; the body is ornamented with about 22 simple raised ribs radiating from umbo to margin, where they are somewhat broader ; the interspaces are deep and somewhat narrower than the ribs, and there are eight of them posteriorly, which broaden out towards margin and are divided by a fine ridge ; the ribs and channels become shallower as they approach the sides ; both ears are similarly ornamented with regular, simple, radiating ridges.

Length, $3\frac{1}{2}$ inches ; breadth, $3\frac{1}{2}$ inches.

Upper Palæozoic mudstones, Maria Island.

AVICULOPECTEN SPRENTII. (NOV. SP.)

Shell truncate-orbicular, longer than wide, slightly convex ; ears comparatively large, sub-equal and symmetrical, broadly wedge-shaped, slightly convex ; both ears are separated from body of shell by a moderately deep sinus, that under the anterior ear being more acute ; there are close, faint, concentric lines of growth on the ears, and body of shell producing an obtusely granular appearance upon the regular flattish radiating riblets ; there are only about 15 riblets running from umbo to margin, towards which they gradually increase by a furcated division of the broadening, intervening spaces ; generally at the extreme margin there are from two to three finer secondary riblets between each primary ; each of the secondary spaces again are faintly divided near extreme margin by a tertiary riblet.

Some of the specimens attain a considerable size as indicated by fragments. The specimen from which the description is taken is about 30 millimetres long, and 30 mil. broad.

Common in Upper Palæozoic sandstones, Porter's Hill, Hobart.

In the larger fragments the radiating spaces between the fine, rounded, primary riblets seem to be bracketed together as a group by the wavy transverse striae, which are also slightly arched between each primary riblet.

Aviculopecten Hobartensis. (nov. sp.)

Shell truncate-orbicular, wider than long, flatly convex; ears widely expanded, somewhat unequal—the posterior one obliquely triangular, slightly concave; the anterior one flatly convex, cuneate, separated from the body of shell by a deep, obtusely angled sinus; surface of ears and body of the shell smooth, marked with a few obtuse concentric lines of growth, and radiated by numerous fine, rounded riblets, more or less regular and simple; the intervening spaces or channels nearly equal in width to riblets; there are about 56 riblets near margin

Length, 53 millimetres; breadth, 45 mil.; length of hinge line, 49 mil.

This is a very distinct form, although at first sight it resembles *A subquinque-lineatus*, from which it is distinguished by its greater relative breadth, and the fineness and regularity of the riblets.

One specimen from Upper Palæozoic sandstones, Porter's Hill.

Aviculopecten Latrobensis. (nov. sp.)

Shell sub-orbicular, slightly convex, a little longer than broad; ears small, small, sub-equal; the posterior one is the smallest and is obliquely wedge-shaped; the anterior ear is produced into a sharply-pointed wing, and is separated from the body of shell by a deep obtuse oblique sinus; both ears and body of shell are ornamented by regular and somewhat sharply imbricated rays; on the body there are about 21 rays proceeding from umbo to ventral margin, separated by channels of about the same width; each channel is divided by a fine, slightly raised riblet, thus forming a regular alternation of large and small riblets. From the appearance of the inner face of the valve, it would seem probable that the outer surface of these imbricated ribs is somewhat squamose, and is more pronounced at distant intervals corresponding with concentric lines of growth.

Length, 46 millimetres; breadth, 43 mil. Occurs with *Spirifera Tasmaniensis* and *Pleurotomaria Woodsii*, in the Marine Tasmanite bed at the Mersey.

This is a very distinct form, and is easily recognised by the regularly, alternating large and small riblets.

Family PECTENIDÆ. *Genus* STREBLOPTERIA. (McCoy.)

Shell ovate or rounded, obliquely extended towards the anterior side; posterior wing broad, undefined, nearly rectangular, extending nearly as far as the posterior margin of the shell; anterior ear small, deeply defined; surface smooth or radiatingly ridged; one large, faintly-marked muscular impression a little behind the middle; one short, narrow tooth slightly diverging from the hinge line on the posterior side of the beaks; ligament confined to a narrow, simple facet on the hinge margin.

These shells differ from the short-winged Aviculæ to which they are most allied by the obliquity of the body of the shell towards the anterior instead of the posterior side. Carboniferous. (Tryon.)

STREBLOPTERIA MORTONII. (NOV. SP.)

Shell small, somewhat ovate, longer than broad, obliquely extended towards anterior side; hinge line straight; beak small, acute, situated near posterior shoulder; posterior wing reduced to a lineal sunken border extending along the whole of the posterior side; anterior ear small, rectangular; posterior side, well-defined, short, oblique, straight, nearly as long as hinge line; anterior side rounded towards inferior angle; anterior ridge well-defined, obtusely rounded near umbo, continues well-defined, near and parallel to anterior slope; surface smooth, with a few distant, faintly-defined, concentric lines of growth which are more pronounced towards ventral margin; ventral margin rounded at anterior side, thence gently curving towards posterior slope,

Length, 24 millimetres; height, 22 mil.; length of hinge line, 12 mil.

Casts common in Upper Palæozoic marine beds, One Tree Point and Porter's Hill, near Hobart.

FAMILY ANATINIDÆ. *Genus* CARDIOMORPHA. (Koninck.)

Shell isocardia-shaped, smooth or concentrically furrowed; umbones prominent, hinge edentulous; hinge margin with a narrow ligamental furrow, and an obscure internal cartillage groove. (Tryon.)

CARDIOMORPHA GRYPHOIDES. (de Koninck.)

Shell globular, inflated; umboes remarkably arched and laxly recurved; approximating surface of valves ornamented with fine, regular, concentric lines of growth.

Length, 75 millimetres; thickness across valves (somewhat distorted and compressed), 67 mil.

I have no hesitation in referring this form to *C. gryphoides* (de Koninck), although the specimen is distorted somewhat.

Upper Marine beds, Mersey, associated with *Gangamopteris angustifolia.* (McCoy.)

CARDIOMORPHA (?) MINUTA. (NOV. SP.)

Shell minute, somewhat compressed, wedge-shaped; beaks greatly expanded, approximate, but slightly recurved; surface with distinct concentric grooves, the interspaces being regularly, concentrically ornamented with fine striæ.

Length, 13 millimetres; breadth, 10 mil.

This very curious form is doubtfully referred to *Cardiomorpha.* Only one slightly imperfect specimen obtained from Upper Palæozoic sandstones, River Styx.

FAMILY ANATINIDÆ. *Genus* EDMONDIA. (Koninch.)

Shell oblong, equivalve, thin, concentrically striated, close; umbones anterior; ligamental grooves narrow, external; hinge line thin, edentulous, furnished with large oblique cartillage plates placed beneath the umbones, and leaving space for an ossicle, or the plate may be equivalent to the sub-umbonal blade in Pholas; pallial line simple? (Tryon.)

EDMONDIA (?) DUBIA. (NOV. SP.)

Shell small, broadly oval, inequilateral, about one-third longer than broad, regularly convex; beaks small, slightly recurved, situated nearer anterior side; surface ornamented with regular and somewhat coarse lines of growth.

Length, 24 millimetres; height, 24 mil.; thickness, 9 mil.

This form is abundant in Upper Palæozoic sandstones, River Styx. It is doubtfully placed under the *genus* Edmondia, although closely resembling *Cardiomorpha striatella* (de Koninck), from which it differs in the umboes being placed nearer anterior side, and in having the dorsal margin more decidedly arched.

FAMILY AVICULIDÆ. *Genus* INOCERAMUS. (Sowerby.)

Shell inequivalve, ventricose, radiately or concentrically furrowed; umboes prominent; hinge line straight, elongated; cartillage pits transverse, numerous, close set. (Tryon.)

INOCERAMUS (?) ELEGANTULA. (NOV. SP.)

Shell somewhat quadrangular, equilateral, hinge line and anterior slope straight, forming a rectangle; surface of valve divided by an oblique obsolete ridge proceeding from umbo, situated at angle between hinge line and anterior slope, and continuing to lower extremity of posterior slope; there is a shallow trough between ridge and hinge line; below ridge the valve is gently convex; posterior slope with a shallow sinus

between hinge line and extremity of posterior ridge, rounded inferiorily; ventral margin curved; surface with distant, obsolete, concentric lines of growth, which follow the curve of the sinus above posterior ridge; there are fine microscopic elongate punctures arranged quincuncially as seen under the lens.

Greatest breadth at hinge line, 35 millimetres; length, 32 mil. Upper Palæozoic Marine beds, Porter's Hill, Hobart.

FAMILY MYTILIDÆ. *Genus* LITHODOMUS. (Cuvier.)

Shell cylindrical, inflated in front, wedge-shaped behind; epidermis thick, dark; interior nacreous. (Tryon.)

LITHODOMUS AUSTRALIS. (NOV. SP.)

Shell very elongate, wedge-shaped, inflated in front, contracted anteriorly; greatest breadth about one-third of the length; there is a shallow, lateral, diagonal depression proceeding from a point near umbo to margin, forming a broad, shallow concavity in the latter; surface of valves marked with distinct concentric lines of growth which coalesce anteriorly.

Length, 77 millimetres; breadth, 28 mil.

One slightly imperfect specimen in Tasmanian Museum, from Bridgewater limestone. (Up. Pal.)

FAMILY MYTILIDÆ. *Genus* MODIOMORPHA, (Hall.)

Shell equivalve, very inequilateral, compressed subovate; beaks small, compressed within the anterior third of the length; surface with rugose or undulating concentric striæ, usually coalescing or fasiculating anteriorly; valve crossed, crossed obliquely by a more or less distinct sinus constructing the basal margin; anterior end rounded; hinge with a single, strong, wedge-shaped tooth in the left valve, and a corresponding cavity in the right valve; no lateral teeth; ligament external, attached to the thickened margin of the shell; pallial line entire. (Tryon.)

MODIOMORPHA ORNATISSIMA. (NOV. SP.)

Shell very inequilateral, compressed, mytiliform, subovate, nearly twice as long as broad; beaks minute, situated near the crown of the anterior side, which is comparatively narrow; posterior side broadly rounded; dorsal margin gently arched towards posterior; ventral margin slightly concave near the middle; surface ornamented with somewhat distant rugose or undulating lines of growth, which coalesce towards margins anteriorly; interspaces marked with microscopic concentric striæ, and these again are in many casts crossed with fine radiating lines forming a fine network.

Greatest length, 42 millimetres; greatest breadth, 20 mil.

Common as casts in Upper Marine beds (Up. Pal.), Porter's Hill, Hobart.

FAMILY ASTARTIDÆ. *Genus* NOTOMYA. (McCoy.) (Mœonia, Myonia, Pyramia, Cleobis.)

Shell transversely oval, sub-equivalve, inequilateral, solid, slightly gaping at both ends; hinge with one strong tooth in the right valve, which appears to correspond to a pit in the left; two muscular impressions are large and deep; a third small accessory one is situated above the interior large one; pallial sinus very small, or only indicated by a truncation of the pallial line; ligament strong, external. (Tryon.)

NOTOMYA GOULDII. (NOV. SP.)

Shell large, ventricose, solid, triognal, hatchet-shaped, inequilateral; umboes gibbose; beaks approximate; posterior slope somewhat rounded and truncate, with compressed and slightly-winged margin; anterior slope straight, longer than posterior, contained angle between both slopes fully 90 deg; a deep and obliquely curved furrow or depression on both valves runs from a point near the umboes, and continues to the ventral margin, dividing each valve into two symmetrical wedgel like lobes, and forming a somewhat deep sinus at ventral margin, the anterior lobe being larger and more produced; the surface of both valves is ornamented with very coarse, irregular, concentric, cord-like sulci, which follow the sinuation produced by the deep mesial furrow.

Breadth, $6\frac{1}{2}$ inches; length, 7 inches; greatest depth of both valves at umboes, $4\frac{1}{2}$ inches. Not uncommon in the Maria Island limestones. (Up. Pal.)

NOTOMYA TRIGONALIS. (NOV. SP.)

Shell large, trigonal, ventricose, thickest at umboes, inequilateral; beaks roundly obtuse, incurved, approximate; anterior slope almost straight; posterior slope slightly depressed and produced, scarcely arched; posterior ridge arched towards anterior shoulder, obtusely rounded, and becoming obsolete towards interior angle of posterior slope; ventral margin gently curved, obtusely rounded at base of posterior slope; sharply rounded, almost angled at base of anterior slope; surface of valves ornamented with regular, comparatively fine concentric striæ, and with distant obsolete concentric undulations; angle contained between slopes fully 90 deg.

Length, $5\frac{5}{8}$ inches; breadth, 4 inches; thickness at umboes, $3\frac{3}{8}$ inches.

This shell approaches more closely to *M. gracilis* (J. D Dana) than to any other form, but differs from the species named in size in the straighter slopes and in the gently-curved ventral margin. Western Tiers, Tasmania.

Notomya Beddomei. (nov. sp.)

Shell large, thick, elongate, very convex, inequilateral; length fully twice the breadth; beaks gibbose, laxly incurved and approximate, situate at the anterior quarter of the valve; posterior slope gently arched and greatly produced; posterior margin slightly compressed; posterior ridge greatly arched, obtusely angular, abruptly sloping dorsally, and disappearing before reaching the posterior inferior angle; anterior slope oblique, concave under incurved beaks, and rounded inferiorly; ventral margin gently curved, obtusely rounded at junction with posterior slope, more acutely rounded at posterior slope; surface ornamented with a few flattened, distant, concentric folds, which become more dense towards anterior side.

Length, $7\frac{1}{2}$ inches; height, $3\frac{1}{2}$ inches; greatest thickness through centre of both valves, — inches.

One fine specimen in Tasmanian Museum, collected at Bridgewater Limestone Quarry by Captain Beddome. (Up. Paælozoic.) The only shell which approaches the above is *N. elongata* (de Koninck), from which it is easily distinguished by the concave anterior slope, and the absence of a mesial furrow or depression.

Family Astartidæ. *Genus* Pachydomus. (Morris.) (Megadesmus.)

Shell oval, ventricose, very thick; ligament area external; lunette more or less distinct; hinge line sunk; teeth, one or two, in each valve; adductor impressions deep; anterior pedal scar distinct; pallial line broad and simple, or with a very shallow sinus. (Tryon.)

Pachydomus Koninckı. (nov. sp.)

Shell transversely oval, solid, thickest at umboes: breadth about three-fourths of the length; dorsal margin arched; valves regularly convex; surface ornamented with numerous, somewhat regular concentric striae; umboes thick, greatly recurved, and mutually touching each other; some of the specimens attain a large size, and become very thick at the hinge; there is a single tooth, large and blunted, fits into a corresponding cavity in the hinge of each valve; the layers of growth on hinge and teeth are very obvious.

Specimen of moderate size.

Length, $3\frac{7}{8}$ inches; height, 3 inches; thickness, 2 inches.

Very common in Up. Pal. rocks at Cheshunt, St. Paul's River, Ross, Styx River, Bridgewater, Hobart, One Tree Point, Bruny, Maria Island.

This shell is no doubt identical with the form figured and described as *P. globosus* by de Koninck, but quite distinct from

original form figured and described by J. Sowerby. (See Mitchell's *Three Exped. Aust.*) and Strezlecki's Phys. Descrip. of N. S. Wales and Tasmania, p. 272, plate x., figs. 2 and 3. Both species are common in the limestones at Maria Island. *P. Koninckii* is much more compressed, with dorsal margin more rounded or arched; the sinus under umbo is more concave, and relatively the thickness is not half so great as in *P. globosus*.

PACHYDOMUS HOBARTENSIS. (NOV. sp.)

Shell large, orbicular, thick, moderately convex, equilateral; beaks recurved, approximating, gibbose; there is a prominent saddle-shaped tooth immediately under beak of left valve, the anterior wing of which is prolonged, and runs some distance parallel with curve of interior sinus; anterior slope slightly concave under beak; posterior and dorsal margins almost perfectly rounded; surface of valves ornamented with coarse concentric striæ.

Length, $4\frac{3}{4}$ inches; breadth the same. Common in the limestones of Upper Pal. age, at the Cascades, Hobart, and in Pachydomus beds, Maria Island.

The almost perfectly orbicular form of this species distinguishes it from all other allies.

FAMILY ASTARTIDÆ. *Genus* PLEUROPHORUS. (King.)

Shell oblong; dorsal area defined by a line or keel; umbones anterior depressed; hinge teeth, 2·2; laterals, 1·1; elongated posterior; anterior adductor depression deep, with a small pedal scar close to it, and bounded posteriorly by a strong rib from the hinge; pallial line simple.

PLEUROPHORUS QUINQUECOSTATUS. (NOV. sp.)

Shell oblong-oval, compressed, very inequilateral; surface ornamented with fine concentric striæ; there are fine, somewhat broadly obsolete or flattish ridges radiating diagonally from umbo to margin across the posterior half of shell; at the junction of each ray the concentric striæ are sharply angled.

Length, 64 millimetres; height, 27 mil.

This is a very singular form, and easily distinguished from *P. Morrisi* (de Koninck) by the compressed form and the fine, flattened diagonal rays. Bridgewater limestone. (Up. Palæozoic.)

FAMILY ARCIDÆ. *Genus* TELLINOMYA. (Hall.) (CTENODONTA, Salter.)

Shell elongately oval, sub-equilateral, smooth, or finely concentrically striate; valves moderately convex; hinge represented by two diverging comb-like denticulated margins without

a special hinge area between them and the beak, and below the latter not interrupted by a pit; ligament apparently external, posterior to the beak. (Tryon.)

TELLINOMYA ETHERIDGEI. (NOV. SP.)

Shell inequilateral, trigonal, elongately oval; concentric striæ well-defined; valves moderately convex; anterior side straight and somewhat truncate, rounded inferiorly; posterior slope longest, scarcely concave, produced to a sharp point; ventral margin gently curved, simple.

Length, 13 millimetres; height, 27 mil.

Common in Upper Palæozoic Marine beds at Porter's Hill, Hobart.

This shell is easily distinguished from T. Darwinii, by its more convex valves, and by its more narrowly elongate form.

CONULARIA. (Miller.) (Sowerby, 1818.)

Etym Conulus (a little cone.) Syn. Conulites, Schloth, *Distr.* Fossil about 100 sp. Silurian to Carb. N. America, Europe, India, Australasia.

Shell four-sided, straight, and tapering, the angles grooved, sides striated transversely, apex partitioned off; the Conularia were the giants of the Pteropoda. *C. inornata* (Dana) of Australia is supposed to have been 16 inches long. (Tryon.)

CONULARIA DERWENTENSIS; (NOV. SP.)

Shell quadrangular, pyramidal; section rectangular; apical angle of larger sides about 25 deg., relation of the two larger sides to the two small ones, nearly as 4 to 3; faces flat or very slightly convex. A strong longitudinal furrow runs down each of the lateral angles, and a faintly marked one longitudionally divides each face into two equal parts; transverse thread-like riblets gently symetrically arched on each face sometimes interrupted and alternate at the point where they are intersected by the faint mesial longitudinal furrow, but generally continuous; riblets coarser and more distant than in *C. lævigata*; gradually increasing in density from base to apex; near the latter there are 10 in the space of 10 millimetres, near the base there are only from 5 to 6 in the same space. It is evident that the riblets were minutely granulated as the upper riblets still preserve this character, together with fine vertical striæ in the interspaces. In the lateral channels the riblets bend abruptly towards apex, and become interrupted and alternate at junction with the riblets of the succeeding face. Sides gently sloping inwards near basal margins.

Length of perfect specimen, $5\frac{1}{4}$ inches; greatest diameter, 49 millimetres by 37 millimetres.

There are two fine specimens in the collection of the Tasmanian Museum. The species is readily distinguished from C. tenuistrata, and other forms by its much wider apical angle. Dr. Waagen has recently figured a portion of a similar form from the olive group of the Salt Range, India, where it is associated with *C. lævigata* and *C. tenuistrata* as in Tasmania.

Conularia Lævigata (Morris).

Shell smooth, elongate, pyramidal, rectangular, gradually decreasing; two of the faces larger than the other two; faces slightly concave, longitudinally sulcated at the lateral angles, ornamented with equal transverse ridges, forming a slightly obtuse angle in the mesial furrow, where they alternate with each other; ridges terminating at the bottom of the lateral channels, curving slightly upwards, and alternating with each other, producing a somewhat granulated ridge, apical angle very acute, not exceeding transverse, striæ simple, somewhat sharp, close, and regular—16 in the space of half-an-inch.

Locality. One imperfect cast from Upper Palaeozic limestones, River Styx, and occasionally found at Porter's Hill associated with *Spirifera convoluta*, *S. glaber*, *S. Tasmaniensis*, *S. duodecimo-costata*, and other well-known forms. Occurs also at Yass Plains, New South Wales.

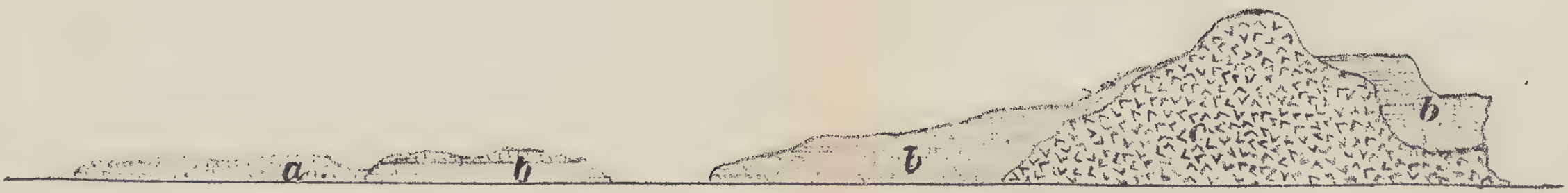
NOTES ON THE GEOLOGY OF BRUNI ISLAND.

By Robt. M. Johnston, F.L.S.

[*Read April* 13, 1886.]

Bruni Island is separated from the mainland of Southern Tasmania by the tortuous course of D'Entrecasteaux Channel. Its greatest length—north and south—from Kelly's Point to Bruni Head is about 31 miles. Its breadth is extremely variable. A mere strip of sand over seven miles long divides Isthmus Bay on the western side from Adventure Bay on the eastern side, and the same narrow neck forms the junction between North Bruni and South Bruni. The breadth of North Bruni varies from five to seven miles, and the breadth of South Bruni varies from three to $10\frac{1}{2}$ miles.

This variation in breadth is caused by the deep and wide indentations of its numerous bays, among which may be mentioned—Barnes Bay, Great Bay, Isthmus Bay, Little Taylor Bay, Great Taylor Bay, Cloudy Bay, and Lagoon, Adventure Bay.



IDEAL SECTION,

ACROSS NORTH BRUNI FROM WOODCUTTER'S POINT TO VICINITY OF TRUMPETER BAY.

a. Brownish bedded Sandstones.

b. Fossiliferous Marine Beds, Up. Palæozoic.

c. Diabasic Greenstone.

With the exception of Mount Bruni in the south, and associated greenstone spurs, there are no ranges of great altitude.

The characteristic vegetation is identical with that on the neighbouring shores of the mainland.

On the coast line and on open slopes we have the following shrubs and trees, namely :—*Casuarina quadrivalvis*, *Eucalyptus globulus*, *E. viminalis*, *Banksia marginata*, *Acacia melanoxylon*, *A. Riceana*, *A. verticellata*, *A. longifolia*, *A. mollissima*, etc.

In valleys, and especially in the deep ravines of South Bruni, exist *Eucalyptus gigantea*, *Pomaderris apetala*, *Fagus Cunninghami*, *Atherosperma moschata*, *Anopterus glandulosum*, *Lyonsia straminea*, *Aster argophylla*, *Phyllocladus rhomboidalis*, *Dicksonia antarctica*, etc.

Bruni Island in character and appearance seems to be a simple prolongation of that notable spur running southerly from the slope of Mount Wellington, and rising into remarkable prominences at Mount Nelson, Bonnet Farm, and Mount Pearson. Like the northern portion of this spur the fundamental rock of Bruni Island, here and there rising into bold crests as at Fluted Cape and Mount Bruni, is essentially a diabasic greenstone.

The eastern and western shores differ widely in character. Along the former the shoreline is generally bordered by bold cliffs, often exceeding 100 feet in height. Where there are no bays or deep indentations the faces immediately washed by the sea are composed of greenstone, which for the most part is overlaid by thin regular and almost horizontal stratified beds composed of the marine mudstones, limestones, and conglomerates of Upper Palæozoic age. In this respect the character of the cliffs is identical with that already described by me in a section of the coast line between Blackmans Bay and Pearson Point.

As might be expected the rocks within the bays are to a larger extent composed of the softer stratified layers, and, from this circumstance, they are less able to resist the destructive action of the sea waves. On the western coast line there are no cliffs or ridges of any great height with the exception of the coast line near Bruni Lighthouse, south of Great Taylor Bay. This is accounted for by the fact that the western coast is to a large extent composed of the softer rocks (sandstones and mudstones), and more particularly because, with the exception of the stratified rocks at Adventure Bay, the mudstones and sandstones slope to the west in the direction of the prevailing dip, which varies from 10° to 20° west, or west by south.

The general effect of this dip from east to west as affecting the respective coast lines is well illustrated by the stratified

rocky island of the Iron Pot, which exhibits the same character on a small scale.

The greenstone axes generally trend north and south, and the marine beds invariably quietly repose upon their bases, or abut against their slopes up to a height of from 300 to 400 feet. In the northern part of the island sandstones—red and brown—immediately succeed the mudstones, and correspond with them in the dip to the west. The position of these sandstones have not yet been ascertained satisfactorily.

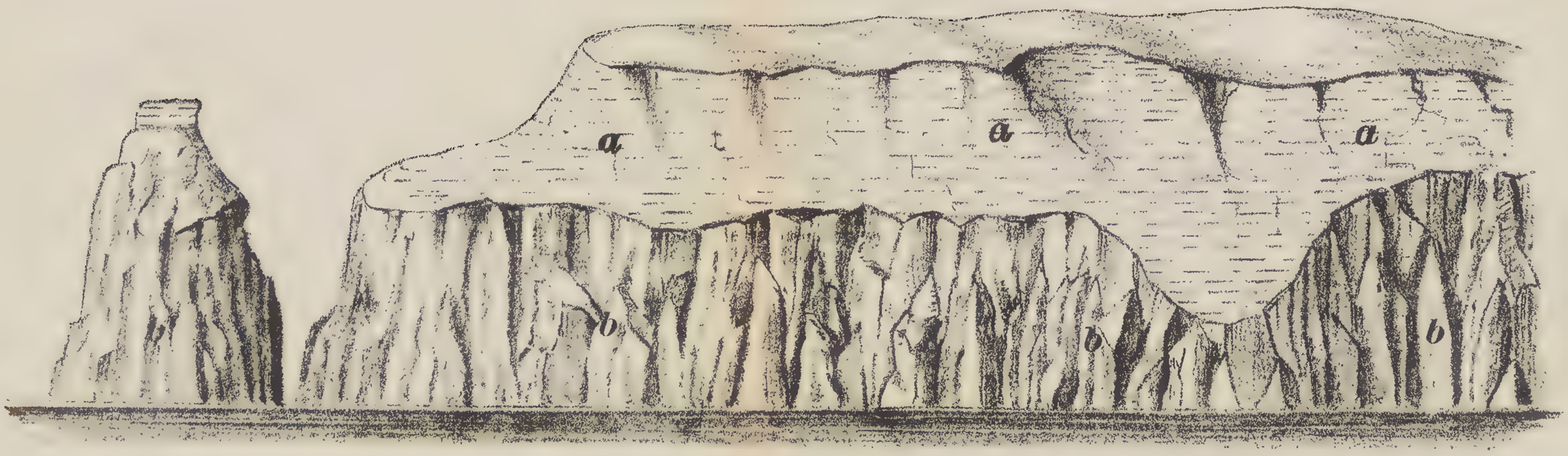
Adventure Bay.

In Adventure, near Quiet Corner, the lower coal measures occur resting conformably upon the marine grits and sandstones of Upper Palæozoic age. There appears to be no stratigraphic break between the two groups. On the northern side the dip of these groups is from 10° to 15° due south.

In traversing the coast line from the Sandy Neck to Quiet Corner the following rocks crop up to the surface in stair-like ledges, remarkable for their regularity :—

		FOR ABOUT
1.	Marine gritty conglomerates and indurated sandstones and mudstones, in which there are at rare intervals thin bands containing the following fossils sparingly, viz.:—*Spirifera Strzelecki, S. Darwinii, Peterinea macropteras* silicified trunks of a fossil conifer of great size	1760 yards
2.	Similar beds, apparently devoid of fossils ...	880 „
3.	Band of indurated carbonaceous shales	12 „
4.	Laminated sandstones, white and red, with ripple marks	440 „
5.	Sandstones and black and grey carbonaceous shales	440 „
6.	Grey shales and laminated sandstones in their beds...	440 „
7.	Brownish coarse sandstones, with false bedding, evidently formed by Æolean agency	440 „
8.	Bosses of sandstones, at intervals similar to 7, but dipping more abruptly to the south-east...	
9.	Whitish sandstone, evenly and more horizontally bedded	440 „
10.	Long sandy beach, low-lying coast, continuing to Bennet's Corner, where the greenstone slopes of Fluted Cape are reached	

It is in the neighbourhood of No. 5 where the coal seam worked by Mr. Zschachner occurs. I was greatly surprised to find that the carbonaceous group at this place belonged to the lower coal measures, for the prevailing impression hitherto was that all the coal measures of the south and east



SECTION AT CAPE FREDERICK HENRY.

a. Upper Palæozoic Marine Beds.

b. Diabasic Greenstone.

belonged to Mesozoic age. It is probable that the coal seam known to exist a little further to the south of the Arched Island is a member of the same group, as well as the coal seams occurring south of Port Esperance towards Whalehead. The true position of the coal measures was first suggested to my mind by the intimate stratigraphic relations which subsisted between the members of the coal measures and the underlying marine beds.

This supposition was afterwards confirmed by my discovery of well-known lower coal measure plants, which appear to be restricted to two very thin bands of dense carbonaceous shale situated immediately above and below the seam of coal now being worked.

The following is a list of all the plants observed by me.

1. Gangamopteris spathulata.
2. ,, obliqua.
3. Glossopteris Browniana, var. praecursor.
4. Portion of a fruit with inbricate scale impressions of irregular pentagonal form.
5. One or two fruits identical with forms common in the Mersey coal shales.
6. One specimen of a large fruit.
7. Impressions of various fern-like stems.

These plant impressions are abundant in the two bands of shale already referred to, but I could not succeed in tracing any plant impression in the laminated shales—grey and black—so largely developed above and below the margin of the coal seam, and extend for about a mile along the shore some distance north of Quiet Corner. No trace of any plant could be found which corresponded with any one of the many forms which characterise the Mesozoic coal measures so widely distributed throughout Tasmania.

The only difference discernible between the species of *Gangamopteris* and *Glossopteris* found in the Mersey Basin and at Adventure Bay is that in the latter place they appear to be very much more dwarfed. But these features are not of much value as the neuration, form, and size of the various species of these genera are remarkably variable in the Mersey shales. It is worthy of remark that I was unable to discover any trace of *Noeggerathiopsis*, which is commonly associated with *Glossopteris* and *Gangamopteris* in the Mersey Basin, and also in a similar position in New South Wales.

Taking all these circumstances into consideration, I am of opinion that these beds clearly belong to the lower coal measures of Tasmania. Mr. Zschachiner has kindly supplied me with the following information with respect to the two shafts sunk to the coal seam now being worked.

The first or eastern shaft is 90 feet deep, and passes through the following strata:—

Thinly-bedded sandstones and shales	16	0
Brownish sandstone	18	6
Shale	4	0
Thinly-bedded sandstones and shales	20	0
Sandstone	2	6
Shale	0	11
Sandstone	3	0
Thinly-bedded sandstones and blackish arenaceous shales	23	1
Coal	2	0
Total	60	0

Sandstone.

There are numerous curious "jumps" or minor dislocations between the east and west shaft, which latter are 200 yards apart. These faults cause an upthrow and downthrow alternately of about 2 feet; that is about the thickness of the seam. To the west of the last or west shaft there is an important fault, throwing up the coal 32 feet.

The direction of this important fault is very irregular. It appears to have a north and south trend with its underfoot to the east.

West Shaft.

The section of the west shaft which is being worked is as follows:—

Sandstone	15	0
Shale and sandstone...	20	0
Shale	3	6
Sandstone	2	6
Sandstone and Shale...	29	0
Coal	2	0
	73	0

Sandstone.

The coal measure basin is of limited extent, following the lower levels between the greenstone ridges, and following in the direction of the South-western Coast. If we consider the dip to be continuous for the two miles over which the beds are exposed, it is probable that the whole formation does not exceed 800 feet in total thickness. Some of the members appear to contain fair sandstones for building purposes.

One Tree Point.

An interesting section of the marine mudstones is exposed at One Tree Point, North Bruni, in cliffs varying from 70 to 300 feet in height.

The beds dip as usual to the west, and are for the most part composed of regular thin layers of grits, conglomerate,

limestones, and arenaceous mudstones of a white and yellow colour. The members at the base, on the sea margin, consist of grits interlaminated with bands of conglomerate, among which scarce a trace of animal life can be observed.

Waterworn and angular fragments of granite, altered slates, porphryies quartzites, and greenstones (rocks unknown in the vicinity) are most abundant. Some of the blocks are huge like those found by me some years ago underneath the Eurydesma and Pachydomus beds at Darlington, Maria Island.

At the time I described the Maria Island formation, it will be remembered that I was inclined to ascribe the transport of these great erratic blocks to ice action.

Conglomerates of a similar character occur in, similar formation at Bacchus Marsh (Victoria), Wollongong, and Blue Mountains (New South Wales), Queensland, and in the Talchir boulder-bed, India. It is now of additional interest to find that R. D. Oldham, Deputy-Superintendent of the Geological Survey of India, and Dr. Waagen concur in ascribing the formation of beds, which are the analogues of the Upper Palæozoic marine beds of Tasmania, to the influence of glacial action*. Dr. Waagen's views respecting the existence of a glacial period at the close of the Palæozoic age in India and Australia are of such interest that I am constrained to reproduce some of his remarks. He states :—"The enormous development of boulder beds that have been formed under the influence of the action on this ancient southern continent makes the supposition of very low temperature during those times on that continent an absolute necessity. These low temperatures were not of a local occurrence only, but spread on the whole continent, thus indicating a true glacial period - a glacial period that was in the beginning restricted to the Southern Hemisphere, and only later on spread also to the Northern one."† In the earlier times of the carboniferous period a rather high mean temperature must have prevailed on the Southern Continent as luxuriant forests of carboniferous plants were thriving there, of which the remains have been preserved to us in Australia as well as in South Africa. All of a sudden a considerable lowering of the temperature took place, ice began to be formed in South Africa and India, and all the carboniferous flora was destroyed in these countries, as well as in Australia, by this low temperature. In the meantime in Australia a

*Palæozoic glacial beds of the Salt Range (Waagen), Indian and Australian coal bearing age (Oldham). *Records Geological Survey, India*, vol. xix, pt. 1,

†According to Ramsay there is evidence of a glacial period during the accum.

new flora began to appear—a flora that was suited to support moderate or less temperature. Notwithstanding the ice-covered part of the Southern Continent the flora spread slowly westward from Australia during upper carboniferous and permian times to reach Indian and South African regions." This flora (Glossopteris and Gangamopteris, etc.) was referred to at first as "Mesozoic" types, but very strict investigation has now proved them to have existed in Australasia prior to the close of the Palæzoic era.

Dr. Waagen concludes:—"The Palæozoic fauna and flora was that of warm climates. The organisms composing these were not able to endure great changes in temperature. As then, towards the termination of the Palæozoic times, first in the Southern and later on in the Northern Hemisphere also, the general temperature was considerably lowered, a circumstance which is proved beyond doubt by the frequent occurrence of ice-formed boulder-beds, the whole fauna and flora necessarily perished. It was afterwards replaced by a more hardy set of organisms, which, however, by degrees occupied the place previously taken up by the Palæozoic forms."

These conclusions of Dr. Waagen are worthy of consideration, for the barren conglomerates and mudstones so largely developed above the Fenestella Zone in Tasmania, towards the close of the Upper Palæozoic age, testify of a condition of things which was prejudicial to organic life, and whatever differences of opinion may exist as regards the exact time which the glacial period may have covered, there is no doubt that the hypothesis partly explains the barrenness of the Upper Palæozoic marine beds and the sudden break which locally exists between the lower and upper coal measures.

Returning from this digression to our section at One-Tree Point. I observed above the conglomerate beds a single band of limestone about four feet thick, consisting almost entirely of the fossil remains of *Stenopora ovata*, all the species or which were of an unusually large size. With the exception of silicified trunks of a huge conifer which occurred embedded sometimes in this limestone and sometimes in the conglomerate beds, I could find no trace of any other form of life. One of the fossil conifer trunks was over three feet in diameter. Sections showed the pine structure admirably as well as the numerous regular concentric lines of growth.

From the large number of rings of growth it was evident that the tree was of considerable age when it was entombed in the calcareous mudstones of One-Tree Point.

For one hundred feet above the *Stenopora* band the mudstones were more argillaceous, but devoid of fossils or nearly so.

SECTION AT VARIETY BAY.

a. *Upper Palæozoic Marine Beds.*

b. *Diabasic Greenstone.*

SECTION AT VARIETY BAY.

d. Fenestella zone
c. Spirifer zone
b. Pleurotomaria zone
a. Grits and conglomerates devoid of fossils

} *Unaltered at points of contact with greenstone.*

(e) Diabasic greenstone.

Variety Bay.

The Variety Bay is a small indentation in the mudstone rocks a little north of Cape Frederick Henry. The cliffs here are typical of the whole series from Trumpeter Bay to Adventure Bay. Unlike the mudstone rocks at One-Tree Point the whole series are richly fossiliferous, like the lower beds at Porter Hill.

The following is a description of the section on the southern side of the bay taken in ascending order:—

	Feet.
1. Greenstone.	
2. Hard conglomerates and grits without fossils	4 0
3. Siliceous limestones and mudstones with occasional casts of *Pleurotomaria Morrisiana*	10 0
4. Hard, dense siliceous rock, replete with thin layers almost wholly composed of the casts of *Pleurotomaria Morrisiana*	4 0
5. Silicious limestones with casts of *Spirifera convoluta*; *S. Strzelecki*; *Terebratula sacculus*; *Aviculo-pecten limæformis*, *A. Fittoni*, etc.	12 0
6. Mudstones finely laminated by the abundance of *Fenestella fossula* and *Protoretepora ampla*; together with other common forms	70 0
	100 0

These beds also dip at an angle of about 15deg. to 20deg. to the west.

The beds regularly flank against the greenstone or overlie it, without disturbing the dip or disarranging the characteristic sequence of the several zones. This is also the general character of the relation of the fossil mudstones with the greenstone base from Blackmans Bay to Adventure Bay, a distance of over 20 miles. No one who studies these sections closely can easily arrive at any other conclusion than that the mudstone rocks are younger than the greenstone axis which they either abut against or overlie. It is upon such evidences as these that I have formed my opinions respecting the age of the Mount Wellington greenstones and its lateral spurs, and not upon the mere evidence of the bore test at the Cascades, although I regard the latter as favourable to the views which I am inclined to take at present.

I am not surprised that my friend, Mr. Stephens, should express such confidence in assigning a more recent date to the greenstones of Mount Wellington when he has succeded in satisfying himself that the presence of pyrites and calcite in the overlying mudstones and limestones can only be due to the supposed intrusion of a mass of greenstone which has been proved not to have penetrated within 519 feet of the present surface of these greatly denuded mudstones.

Geikie, who is no mean authority, states that layers of

calcite with brucite are quite characteristic of limestones found among areas of regional metamorphism where no visible intrusive rock has influenced the phenomena, while pyrites is common in all limestones, and is most widely distributed in all kinds of rocks, especially so in certain coal seams. As for myself, I cannot pretend to speak with such confidence as Mr. Stephens upon such a difficult question. I can only state that I have carefully considered the evidences, and have taken much time and trouble to gather and weigh all facts bearing upon the subject, including the facts and arguments of my friend. But notwithstanding this, I can only still affirm that the opinions advanced by me have merely the force of probability in my mind, from which all doubt has not yet been wholly removed.

The dynamical forces which upheaved and dislocated the stratified rocks on the flanks of our mountain chains operated probably at different intervals during a long course of time, in which movements the mountain chains themselves would also partake. There is abundant evidence throughout Tasmania of the eruption of intrusive greenstone rocks of more recent date than the mesozoic stratified rocks, but that is no reason for assuming that all the greenstone masses are of more recent date than the marine mudstones which so frequently abut and overlie the older diabasic rocks of Tasmania. Nor have we a right to assume that all movements of elevation are immediately due to superficial intrusion of igneous rock. Few mountain chains have been produced suddenly by cataclysms, and while I do not deny that cataclysms and intrusive rocks have operated largely in producing important modifications on the earth's surface, I am still inclined to believe that the more important movements which have resulted in raising stratified rocks to immense heights above sea level, as on our mountain tiers, are often intermittent, slow, and cover a vast period of time.

It is hoped that the information now produced with respect to important sections on the East Coast of North Bruni may be of service in arriving at more satisfactory conclusions in all matters to which they relate. I am only anxious for the truth of my opinions, and therefore shall always be prepared to modify them in accordance with the weight of available evidence.

PERONOSPORA INFESTANS. *MONT.*

Potato Peronospora.

By R. A. Bastow, F.L.S.

Read May 18, 1886.

Natural order VIII.—Fungi.

Sub-order IV.—Hyphomycetes.

Tribe XVII.—Mucedines. *Hooker's Handbook.*

Peronospora infestans. Threads of mycelium slender, always destitute of suckers; fertile thread thin gradually attenuated upwards, with one to five branches; branches either simple or with short branchlets; acrospores ellipsoid or ovoid, apex furnished with a prominent papilla. *Cooke's Handbook of British Fungi*, p. 593. *Cooke Micro. Fungi*, t. 14; f. 264; p. 155. *Pop. Sc. Review*, vol. iii; t. 8; f. 3; p. 193. vol. xiii; p. 151. *Botrytis infestans*, *B. and Br. Ann. N. H. No.* 521. *Journ. Hort. Soc.* vol. 1; t. 4; p. 11. *De Bary. Ann. Sc. Nat.*, (1863), xx. t. 5; vol. 6. *Monthly Mic. Journ.*, 1874, 1875, 1876. *Science Gossip*, vols, xii., xiii. *Gard. Chron.*, 1875, 1876.

On potato stems, leaves, and tubers.

Many theories have been advanced with regard to the origin of the destructive *Peronospora infestans* or potato disease. Meteorological and electrical states of the atmosphere, saturation of the plant by water, degeneration by various methods of cultivation, the ravages of insect life, these and others have each in their time been brought forward as the cause of all the mischief with our potato crops. But the last twenty years of scientific inquiry by Messrs. Cooke, Berkley, De Bary, and more especially the researches of Mr. W. G. Smith, of Mildway Grove, London (to whom was awarded the Royal Horticultural Society's Gold Medal for his discoveries), has done much towards the completion of the life history of this withering blight, many proofs have been obtained of its fungoid origin, and its growth and method of reproduction has been most assiduously traced in its several forms as far as modern appliances will allow of investigations being made.

For much information concerning *P. infestans* given in this paper, I am indebted to Mr. W. G. Smith, who, in reply to my numerous queries in 1879 took the greatest pains to make points clear of which I was doubtful, and could not without assistance come to any definite conclusion, and who also liberally supplied me with slides for comparison.

When the potato plant has been attacked by the disease, the leaves assume a pale tint, and discolored spots appear thereon; if, in this stage of the disease, the underside of the leaf is examined it will be found to be covered with whitish patches, these patches are stems with fruit, and arise from the

abundant septate and branched *mycelium*, or opalescent thread-like roots which grow in the midst of the cells of the leaf, and eventually appear through the stomata as fertile stems; these patches are seldom seen on the upper side of the leaf, on account of the scarcity of the stomata on that side, and because the cuticle is too thick and too strong for the delicate threads easily to penetrate. The mycelium quickly proceeds towards the stem; the stem then becomes spotted with dark brown patches and very soon the tuber is reached and affected. In a day or two, and sometimes in a few hours, the disease which has attacked the leaf proceeds from within, outwards, to bear fruit in conspicuous white tufts. Almost as soon as the white tufts appear on the leaves, brown specks become visible in the tissue of the tuber, the starch grains are affected and discolored by them, the specks become darker and eventually flow together, the cell construction becomes dissolved and the potato is speedily converted into a dark brown semi-liquid mass.

If a section of a diseased leaf is made and observed with an eighth of an inch objective, the hyaline or opalescent *mycelium* or root threads will then be observed creeping amongst the enclosed cells of the leaf, and making their way towards the stem of the plant, branching, increasing, and bearing fruit as they extend.

The fertile stem, *i.e.*, that part of the plant which appears externally through the *stomata* may also be observed growing from the *mycelium*, and eventually through the *stomata*. This fertile stem is very thin, transparent, and is gradually attenuated upwards, it is supplied with from one to five branches, either simple or with short branchlets, not bifid, nor trifid. There are singular nodose swellings on the branches. The tips of the branches are furnished with acrospores or sheaths, and these contain zoospores furnished with cilia apparently for locomotion.

The *P. infestans* appears to be propagated by at least two different processes, each of them being productive in a high degree; these are, by *acrospores* on the fertile stems, and by resting spores on the *mycelium;* they have thus a slight but curious illustration in the potato plant itself, *i.e.*, the potato apple, the fruit; and the potato itself, the tuber.

The acrospores just mentioned as growing on the tips of the branches of the fertile stem are ellipsoid or ovoid in form, papillate at the apex, and slightly pedicellate at the base, one square line will contain 3,270 of them. These acrospores are sometimes called privileged spores or swarm spores.

It would appear that the acrospores are themselves capable of germinating under certain conditions, but more frequently important changes take place in the granulous matter with which they are filled. The granulous matter appears to differentiate,

forming minute separate bodies in the acrospore; these are zoospores, resembling small infusoria. When the acrospore is fully ripe it bursts with some force and scatters the contained minute bodies to some distance; thus liberated they move about very freely by means of their cilia; and then, eventually finding a resting-place favourable to their development, their cilia drop off, and after a little rest, strange as it may appear, a transparent tube or mucedinous thread proceeds from them, and entering by the stomata, they draw their sustenance from the plant on which they rest, producing more mycelium, and therefrom eventually fertile stems with acrospores containing another generation of zoospores.

The branchlets of the fertile stems also produce conidia or secondary spores, sometimes called dust spores; it is assumed that both the acrospores and the conidia are assexual. De Bary states that one square line will contain 19,620 zoospores, under favourable conditions sufficient to destroy an immense number of potato plants; they are thus fraught with much importance to the producers of such an extensively used article of food as the potato.

The second method of propagation is by resting spores, and we find these in and on the mycelium in the midst of the leaf and in the heart of the tuber, they are the production of oginia with antheridia. The antheridia are very small semi-opaque or very faint grey brown bodies attached to the mycelium by fine threads, these are attracted too and are absorbed by the oginia or ovarian sacs which afterwards produce resting spores. The oginia are larger than the antheridia and are of a pale grey brown colour before fertilization, but they become dark brown when the spores are ripe.

When Mr. W. G. Smith first stated that the resting spores under consideration produced *P. infestans*, some eminent Continental scientists were sceptical on that point; and it led to some interesting experiments being made. Some of the turbid fluid which flowed from an infected tuber, and which was almost one mass of mycelium, antheridia, and oginia, was set aside and carefully protected for examination. For three or four days the parts of the fungus floated and grew, the antheridia and oginia conjugated and were present in abundance at the bottom of the liquid, and a photograph of these minute bodies in conjugation was secured. The fertilized oginia, the future resting spores, were then preserved in sealed bottles and placed aside until the month of April in the following year. At that time some of the spores were taken out of the bottle and placed in pure water, some in potato liquor, some in saccharine fluid, some in nitrogen, some between glasses constantly moist, some on broken tiles, and some on the potato leaf as it was growing. These were under

darkened bell-glasses and were carefully examined daily. In nine months the oginia had doubled their size, and from being smooth round bodies they changed into semi-transparent brown rough bodies. The resting spores could then be seen within the oginium or sac, and in some cases two resting spores were within one sac.

In the beginning of May a number of these burst and broke into atoms, discharging a small bladder which also perished in dust; these were supposed to be effete spores. Others became darker, and through their structure the formation of zoospores could be distinctly observed. The zoospores were hyaline, and were eventually expelled, but after laying quiescent for a little time, two curved filaments appeared, they became straight, quivered a little, and swam out of the field of view, similarly to the zoospores from the acrospores on the fertile stem.

The cilia or filaments eventually perishing, the zoospores rested, they then threw out mycelium threads from which a fertile stem with acrospores was propagated; but the conditions being unfavourable, the growth was abnormal. The resting spores did not all produce zoospores, some of them produced a long jointed thread only.

The slides now under the microscope were made eight or ten days ago from dried specimens brought from Lancashire, England. The fertile stem, acrospores, mycelium, and resting spores are distinctly visible in one of the slides; the zoospores may also be observed, but very minute and without cilia. The filamentous white tuft of fertile stems is shown on another slide as an opaque object under a two-thirds of an inch objective. A glance at this object will enable the observer at once to identify the fungus on the potato plant if perchance it should appear in his kitchen garden; it is a beautiful object; it has the appearance of a minute crystal forest; the stems, the branches, and the fruit, all transparent and glittering; its beauty is however but short-lived, for when it touches it destroys, and as its victim falls its own beauty passes away, its power to destroy still remaining.

The *P. infestans* is nearly always in company with the *Fusisporium solani*, and it requires not a little practice to distinguish between the two kinds of spores. The Fusisporium spores are much smaller, 1/2500″ in diameter, and finely muriculated. They are equally destructive.

The *P. infestans* seem to vegetate most luxuriantly on plants that are grown on undrained ground, or on ground that has been dressed with rich hot manure; the plant, being saturated with moisture and forced with the manure, is delicate and appears unable to resist the attack, especially in warm rainy weather.

The crops on sandy soils appear to suffer the least from this

disease, as the air penetrates more freely into the earth, and the moisture passes off more freely. No one seems to know exactly where the disease came from when it so suddenly appeared in the Isle of Wight in 1844, all we know is that it there appeared and that it spread very rapidly.

It may be that the *P. infestans* is a descendant of a fossil species *Peronosporites antiquarius* found amongst the vascular bundles of a Lepidodendron from the coal measures, figured and described in Science Gossip, Vol. XIII., p. 270. It appears that the ovarian sacs visible in that fossil plant contain zoospores as well defined as any to be obtained on living plants, the septate mycelium being equally distinct. The only difference appears to be that the host was not a potato plant; the genus *Peronospora* is not however confined to solanacious plants. The eighteen at present known species of Peronospora attack parsnips, peas, onions, spinach, lettuce, clover, nettles, anemones, poppies, roses, docks, etc., but apparently not in such a destructive manner as *P. infestans* does with potatoes.

THE OCCULTATION OF JUPITER.

By A. B. Biggs.

Read 16*th April*, 1886.

As the visibility of an occultation, like that of a solar eclipse, depends upon the position of the observer, the chance of such an event being visible in any particular locality is rather scanty. On looking down the list of southern occultations of Jupiter for the current year, I saw there were three that came temptingly near us. On working these out, I found that one, that of 16th of April, was in a most favourable position for observation, being near the meridian; but, to my disappointment, that those for March 20th, and May 13th, would be just missed by us; the former being over just before the moon would rise, and the latter commencing just after setting. On 20th March, I had both bodies in the same field of the telescope at rising, the moon having passed the planet.

With regard to the occultation of 16th April, I regret much that, through my not having taken the precaution of obtaining assistance to record notes, and being flurried by the clatter caused by a boisterous wind upon my iron roof, I was not able

to obtain more than half the result I had hoped for. A few thin clouds, moreover, interfered materially with the observations.

The satellites were disposed two on each side the planet. I missed all the contacts of the satellites, except those of the third (in order), which I got, both at immersion and emersion. I also missed the first contact of the planet.

I timed the observations by the sidereal clock, afterwards reducing to local mean time. I may here explain that my clock is with my smaller telescope in the adjoining grounds (Mr. Pullen's garden). I get the time from it to the large telescope by an electric line communicating motion each minute to the hands of a dial, and the clock beats (seconds) I get by telephone. This is just where the trouble came in; the clatter of the wind interfering with my keeping correct count. The times recorded, however, I obtained with certainty, and fair accuracy, as follows :—

	hrs.	min.	sec.
1st Contact of planet (missed)			
2nd Contact (or total disappearance)...	9	25	27·8
3rd Satellite disappeared at	9	33	37·6
At re-appearance—			
The planet just peeped out at	10	2	49·8
And emerged entirely at	10	6	23·2
Third satellite re-appeared	10	14	14

As seen in the $8\frac{1}{2}$in. reflector (power 200, full aperture), the phenomenon furnished a most interesting exhibition. To watch the beautiful markings of the planet gradually disappearing behind the dark limb of the moon, and the extinction of the satellites one by one, and still more, the re-appearance in the same order, was almost enough to distract the attention from the sterner details of minutes and seconds.

Whilst in close proximity, and especially at re-appearance, I carefully studied the relative luminosity of the moon and planet, especially with reference to the question of the planet's being in any degree *self-luminous*. I here became aware of my mistake in having omitted to provide some means of photometry. However, as an eye estimate, I was struck with the apparent *smallness of the difference* in the luminosity of the two bodies, as compared with their vast difference of distance from the sun. Considering that the sun's disc, from the distance of Jupiter, compared with the same as viewed from the moon (or earth), would appear only as about 1 to 25 in surface, I could not but feel impressed with the fact, that the brightness of the planet was out of all proportion to the relative amount of light received by him from the sun. As compared with the lunar surface, it appeared as if the shadow of a thin cloud were cast upon the planet. Still, as against the theory of the planet's being self-luminous by his own glowing heat (as has

been suggested), stands the fact, that the luminosity of the satellites compare about equally with that of the planet. We can hardly imagine these comparatively small bodies to retain any sensible amount of their supposed original incandescence. They may, however, receive a considerable amount of light from the planet itself. This question is one of great interest, and should be investigated, as it probably will be, on a more accurate and scientific basis.

"IS JUPITER SELF-LUMINOUS?"

By A. B. Biggs.

It is with some diffidence that I submit the following paper, partly because I am doubtful of its being a subject of general interest, and partly from a consciousness that the experiments in the course of my investigation of the subject did not attain the degree of accuracy which I had hoped for. Perhaps, however, the fact that the question which I set myself to solve is intimately connected with that of the physical condition of Jupiter, and inferentially also of all the giant planets may lend an interest to the subject.

In the concluding part of my paper on the occultation of Jupiter in April last (read 8th June), I referred to the question of Jupiter's intrinsic brilliancy, and expressed the hope that the question would be scientifically investigated. In order to clear the way, I will first state the case. Jupiter is, roughly speaking, about five times the earth's distance from the sun. It is impossible, therefore, that he can receive from that luminary more than $\frac{1}{25}$ (one twenty-fifth) part of the intensity of illumination which reaches the earth; that is, in inverse proportion to the squares of the distances. Now, from the time of my first telescopic acquaintance with Jupiter, I was struck with the impression that his brightness far exceeds what, by the above rule, it ought to be. The question naturally arises, how is this want of accordance with the laws of radiation to be accounted for, presuming it to exist? Some modern astronomical works just refer to this question, but as a rule they pass it over lightly.

Chamber's Astromony devotes but one short paragraph to the question, from which I quote as follows:—"Bond computed that Jupiter actually emits more light than it receives (!); but whether we accept this problematical result, or the more trustworthy one obtained by Zölner, strong indications of inherent luminosity in Jupiter seem to exist; and this points to the conclusion that this planet is itself a *miniature Sun*." Professor Newcomb says:—"A still more remarkable resemblance to the sun has sometimes been

suspected—nothing less in fact, than that Jupiter *shines partly by his own light*," etc. Guillemin asks:—"Does the globe of Jupiter still possess an internal heat considerable enough to raise the temperature of the crust to an extent sufficient to make up for the relative feebleness of the solar heat?" (and *light*, he might have said) "These are questions on which science is still silent." Herschel, Ball, and Webbe, pass the question by in silence. Mr. Proctor, however, argues strongly in favour of the giant planets being more or less self-luminous.

The recent conjunction of Jupiter and Mars (28 June) was looked forward to with interest by me, as furnishing a favourable opportunity for photometric experiments with reference to the relative intrinsic brightness of these two planets; and I commenced my preparations several days before hand. At the risk of being somewhat tedious, I think it will be well to describe in detail the means I adopted, in order that the results may be judged of at just what they are worth, and no more.

I constructed a diaphragm (or shutter), for the telescope ($8\frac{1}{2}$in. reflector), consisting of two half-discs, pivoted at their circular centres, and graduated on their rims in degrees, thus:—

90
80
70
60
50
40
30
20
10
0

This enabled me to shut off any proportional part of the aperture of the telescope from one half to the whole.

In order to equalise the conditions, so far as to have equal visual areas in comparison, I covered the field-bar of the eye-pieces used with tinfoil (blackened) leaving open (for finding the object) a segment only, about one-third of the field. In the centre of the tinfoil I pierced a small hole with the point of a fine needle.

In observing, I used a Barlow lens in conjunction with the eye-pieces, so as to enlarge the focal image. I at first employed the sun-prism (the image being viewed by reflection from the first surface of clear glass), thereby getting rid of the greater part of the illumination. This was still further reduced by a 6-inch stop to the telescope. For comparison, a lamp was enclosed in a cupboard having an aperture covered with paper. The image of Mars being brought to the needle hole, the shutter was gradually closed until the brightness of the image equalled that of the lamp-light. The different readings gave an average of 90deg. Dealing with Jupiter in the same way, the average was 29deg.

I next varied the experiment by removing the sun-prism, and substituting a dark wedge (a make-shift affair for the occasion, composed of two slips of glass, in contact at one end, the other ends being slightly separated, the intervening space being filled with Canada-balsam mixed with lamp-black). A suitable darkening with this being obtained, it was retained in position, and the shutter used for equalising the illumination.

In this experiment each image was reduced to the minimum of visibility. The averages of the readings were 102deg. for Jupiter, and 146deg. for Mars.

Between these two sets of measures there is considerable discordance; but they both agree in making Jupiter's surface much the brighter of the two; in the first set as 90 to 29, or nearly three times; and in the second as 146 to 102, or nearly $1\frac{1}{2}$. Taking the mean we have as 118 to 65, or nearly double.

Their relative distances from the sun at that date were as 15,747 to 54,561. The proportion of the squares of these numbers is almost exactly as 1 to 12; Jupiter, then, instead of being $\frac{1}{12}$ the brightness of Mars, is by the above measure nearly double, or about 22 times as bright as he ought to be by the laws of radiation.

The near conjunction of Jupiter and the Moon, on 7th July, furnished opportunity for comparison between these bodies. On this occasion the readings averaged 180deg. for

Jupiter, and 80deg, for the Moon. Their relative distances from the Sun were :—

As.	1·0155 to 5·4562
Theoretical illumination (as squares)	1 to 28·8
As measured	4 to 9, or 1 to 2·25
Actual exceeds *theoretical* ...	$\frac{28·8}{2·25}$ = 12·7 times.

I had not yet done with the question. In my experiments I had, by various means, stopped back all but the smallest fraction of the light received. The inquiry arose, did this small amount represent *equal percentages* from both bodies ? I settled this question at home thus :—A small hole $\frac{1}{10}$ inch in diameter was pierced in a bit of sheet metal, and covered with tracing paper. This, with a flame behind it, made a capital artificial planet. I improvised a small telescope out of a short focus photo. combination, using the same eye-pieces as before, and the dark wedge. To this arrangement I adapted a graduated shutter as before described. The light—a small gas flame—was enclosed in a magic lantern, the lenses being removed, Measures were then taken of the intensity of light as received upon the spot of tracing paper, the flame being at 1, 2, 3, 4, and 5 feet distant respectively. The average of a series of readings for these several distances in order was 180, 110, 61, 31 and 6 degrees.

Theoretically they should have been 175, 112, 63, 28 and 7 degrees.

This was, I think, sufficiently near to show the general correctness of the principle.

To sum up then—as compared with Mars, I make Jupiter's surface brightness to be 22 times as great as it ought to be—and as compared with the Moon 12·7 times.

These comparisons, of course, go on the assumption that the surfaces to be compared are equally reflective, that is, of equal whiteness. That they are really *not* so may be considered as certain. But even supposing Jupiter's surface to be of the *whiteness of snow*, we have at the poles of Mars planetary snow with which to compare it, and illuminated with 12 times the intensity of Jupiter's sunshine ; yet, even this comparison, I judge to be in favour of Jupiter. As compared with the Moon, the vaporous envelope of Jupiter (whatever its nature) is probably more reflective than the bare and broken lunar surface. There *must*, however, remain a vast amount of illumination to be accounted for in some other way.

I must say that the result of my measures appears incredible even to myself. I, therefore, look for some corroboration. According to Mr. G. P. Bond's estimate, the light we receive from Jupiter amounts (at a mean) to $\frac{1}{6430}$ of that of full moonlight. Jupiter's visual disc (mean) is $\frac{1}{2553}$

of the Full Moon. My estimate of his surface brightness $= \frac{4}{9}$ that of the Moon. The product of these fractions is $\frac{1}{5744}$—; not far from Bond's estimate.

If, then, we may take it as proved that *solar illumination* is vastly insufficient to account for Jupiter's brightness, how is the excess to be accounted for? Prof. Newcomb says (hesitatingly) :—"A still more remarkable resemblance to the sun has sometimes been suspected—nothing less, in fact, than that Jupiter shines partly by his own light. It was at one time supposed that he actually emitted more light than fell upon him from the sun; and if this were proved, it would show conclusively that he was *self-luminous*." Mr. Proctor favours this opinion, and indeed accepts it as a necessary fact. I think we can come to no other conclusion. The greatest difficulty in the way of this theory is, I think, the relative brightness of Jupiter's satellites. As I suggested in my former paper, they may derive a small portion of their light from their primary, but this, of course, would be apparent to us only in the farther portion of their orbits. On this question, Newcomb says:—"If we assume that the planet emits any great amount of light, we are met by the fact that *the satellites would shine by this light when in the shadow of the planet.* As these bodies totally disappear in this position, the quantity of light emitted by Jupiter must be quite small." If these satellites were seen *in a dark sky* when in shadow, I, too, think they would be visible. By a rough process of calculation (which it would take too long to describe), and taking my own estimate of Jupiter's brightness, I find that his first satellite would receive from him about 50 times the light which our new Moon receives from earth shine, or about $\frac{1}{846}$ of our sunshine, obtained thus :—

Full moonlight to sunlight (mean of several observers)	$= \frac{\text{Sun.}}{550{\cdot}000}$
Earthlight to Moon...	$= \frac{13}{\text{Moon.}}$
Jupiter to Satellite I, at $\frac{4}{9}$ Moon brightness ..	$= \frac{50}{\text{Earth.}}$

$$\therefore \quad \frac{13 \times 50}{550{\cdot}000} = \frac{1}{846} \quad ;—$$

(assuming equally reflective surfaces) as between Earth and Moon. This is about equal to the sunshine received by the satellite of Neptune. But it must be remembered that when Jupiter's satellites enter his shadow, they are in such close proximity to the limb of the planet that such feeble illumination would be totally overpowered by his glare.

The evidence of the satellites appears still further hostile

when we consider that they sometimes appear (the third especially) as *bright* spots when entering upon his surface in transit, as I have myself observed; but this is only for a short distance within the limb. As they advance upon the face of the planet they become *dark* by contrast—sometimes as black as their shadows. This is accounted for by the vast difference of brightness between the centre and the edge of the planet's disc. This last is, I think, compatible with the supposition of a *glowing ball*, whose surface lies far within the confines of the vaporous envelope, which alone is visible to us. As to the satellites, we cannot argue anything definitely or positively from them with regard to the question under discussion, as we know next to nothing of their physical condition; their *variable brightness*, if nothing else, compels us to rank them among the many unsolved mysteries of astronomy.

The subject deserves, and I trust will receive, more precise and thorough investigation.

TASMANIAN MOSSES.

By R. A. Bastow, F.L.S.

The illustrated key, accompanying this paper, is prepared chiefly for the use of students, residing in our country districts, who have not at all times access to the many valuable Botanical works in the Royal Society's Library.

The illustrations are, for the most part, drawn from nature; or, where specimens of the mosses have not been available, the drawings have been taken from standard works on the subject, namely:—"Flora of Tasmania," "Flora of New Zealand," and "Flora of the Antarctic Islands," by Dr. J. D. Hooker, F.R.S.; "Bryologia Britannica," by William Wilson, Esq.; and "Musci Exotici," by William Jackson Hooker, F.R.A. & L.S., and in the accompanying description of species the following works have also been freely used:—"Bridel, Bryologia Universa;" "Hooker's Handbook of the New Zealand Flora;" "Fragmenta Phytographiæ Australiæ," by Baron von Mueller; "Musci Austro-Americani," by Mitten; "Australian Mosses," by Baron von Mueller; "Mitten's Catalogue of Australian Mosses;" and MSS. from Mr. H. Boswell, of Oxford.

The genera are all arranged on one large sheet so that the whole may be presented at one view. The drawings on the upper half of the sheet are so placed that

the particular generic points may be presented to the eye; so as to make the meaning of the botanical terms more clear, a very simple sketch very often succeeding in conveying an idea better than much verbiage. The drawings on the lower half of the sheet are illustrations of distinct species in the genera immediately under whose names they stand; the key is thus made to impart some idea of at least one species of each genus, and these amount to over a fourth part of all the species of mosses in Tasmania. It may also be observed that such species, as are represented, are drawn first to their natural size, and, immediately below, as they appear under an $1\frac{1}{2}$ "Objective"—the small space between the natural-sized drawing and the magnification being filled in with such details as tips of leaves, forms of teeth, &c., peculiar to the species, the name of which is printed immediately underneath.

Having before us a very small moss plant, perhaps, if we essay to identify this, we shall obtain a more certain idea of the manner of using the key. The plant was collected by Mr. R. G. M'Leod, near to Evandale. It is indeed a gem, although altogether only about three-eighths of an inch in length. The leaves appear rather larger than is usual in such plants, the fruitstalk is most gracefully curved and is apparently a prolongation of the stem. Let us endeavour to find out to which of the numerous genera in the key this plant is to be assigned:—

1st. We find at the top of the key all the mosses of Tasmania are divided into two sections—these are, terminal fruiting or acrocarpous mosses, and side-fruiting or pleurocarpous mosses. As we observe the plant before us we cannot have the least doubt as to which of these sections it does belong to: it is certainly terminal-fruiting, and consequently it must be assigned to some genus included in the long bracket containing Nos. 1 to 56 inclusive. Nos. 57 to 82 may therefore be lost sight of as far as regards the plant under consideration.

2nd. It will be observed that the long bracket which must include the genus we are seeking contains:—*a*. Mosses whose capsules are without lids. *b*. Mosses whose capsules are without peristome or teeth. *c*. Mosses with a peristome of one row of teeth only. *d*. Mosses with double rows of teeth. *e*. Mosses whose leaves are distichous, *i.e.*, inserted in two opposite rows, something after the manner of fern-fronds—To find out to which sub-section under the long bracket the little plant belongs is our next care. Its parts are too small for observation, with unaided vision; we therefore place it under the microscope, and with the aid of a pair of fine tweezers the calyptra or veil, which covers the capsule as with a helmet,

is removed. The lid must also be removed with a fine pointed knife or needle, and now a beautiful double peristome is in view. The plant therefore belongs to that division of mosses under the long bracket that has two rows of teeth, and must be looked for between the numbers 41 and 55 inclusive. The range is thus considerably narrowed.

3rd. But, again consulting the key, we find that the terminal fruiting mosses whose capsules have two rows of teeth, are again divided in two sections, namely, those with flat capsules, and those with terete or round capsules. The capsule on our plant is exactly round in section; we may therefore dismiss No. 41 from consideration, and confine our search for the genus amongst Nos. 42 to 55 inclusive—*i.e.*, to mosses whose fruit is terminal, with double peristome, and with terete or round capsules with short teeth, definite in number.

4th. But by the key we are informed that terminal fruiting mosses, with double peristomes and with terete capsules, may be again divided, by the form of the calyptra or veil, into those with mitriform calyptra, and those with cucculate or dimidiate calyptra. We have just previously noticed that the calyptra was shaped like a helmet; and if it is in that form, it is assuredly cucculate or dimidiate. We may therefore dismiss Nos. 42, 43, and 44 from notice, for the calyptra of those mosses is mitriform.

5th. We again observe by the key that the bracket containing terminal fruiting, double peristomed, terete capsuled, cucculate veiled mosses are again subject to five divisions, and these are all included in Nos. 45 to 55 inclusive. We will examine these divisions one by one:—Taking the largest division first, we find that the leaves in that division are various and the capsule cylindric. The capsule of our plant is not cylindric, it is pyriform. We consequently dismiss this division, containing Nos. 49 to 55, from further consideration, this small pyriform capsuled plant does not belong to those numbers. There are now only Nos. 45, 46, 47, and 48 to consider. No. 45, Bartramia, has a globose capsule; that is not the genus we require. No. 46 is Zygodon, with an ovoid capsule; we pass over that genus. No. 47 is Codonoblepharum, with erect capsule, and quite similar to Zygodon; this does not correspond with the capsule before us, and consequently we pass it by. No. 48 is the only genus left for consideration. The description reads—"FUNARIA, leaves flaccid, cells large, lax. Capsule pyriform, inclined or pendulous. Mouth small, teeth horizontal." On examination of the plant under the microscope we find the generic description on the key faithfully describes the plant, and we have no hesitation in placing it amongst the Funaria.

6th. On examination of the drawing we observe that the plant we have been identifying is there represented just as it appears in its natural size, as it appears with a pocket lens, and as the capsule appears under the microscope; we may therefore not only come to the conclusion that the plant is a Funaria, but that it is also Funaria crispula.

A more minute description of the plant will be found by referring to the index at the end of the specific description.

There are many localities around this city (Hobart) where cryptogamic life abounds, and to a few of such haunts we will briefly allude. The summit of Mount Wellington is an interesting locality to the bryologist, almost every square yard of its rugged surface is garnished with moss, with lichen, or with hepatic; both *Andréæa acuminata* and *A. subulata* are abundant. In the crevices the graceful *Lepidozia pendulina*, and the rich *Jungermannia colorata*, are in rivalry; whilst *Leptostomum gracilis*, in the most genteel manner, tosses its nut-brown capsules in conscious superiority to both. The weather-worn depressions, forming pools on every side, contain *Sphagnum Australe* and *Dicranum Billardieri*; these are strangely altered by surrounding conditions from their normal growth, as they appear in the forests and bogs below. Colonies of *Polytrichum juniperinum* here attain magnificent condition, growing from three to six inches in height, perfectly erect, each plant tipped with a fawn-coloured woolly cap, much in the form of the head-dress which artists generally supply to Robinson Crusoe. The "Ploughed-fields" will amply repay the collector; it is probable that many species of Hepaticæ and mosses will here be found that do not flourish elsewhere. It is almost certain that *Racomitrium lanuginosum* (the wool-bearing moss with a torn calytra) will be obtained. The tips of the leaves of this superb moss are prolonged into thin hair-like points, giving to the whole plant the appearance of being covered with a thin coating of wool. The neighbourhood of the Springs is a perfect paradise of mosses. The beautiful *Hookeria amblyophylla* will here be found—a species of a magnificent genus, whose capsules are of perfect form, and whose leaves are always interesting objects for the microscope on account of their exquisite areolation. A moss of soft texture, yellowish green, and growing freely five or six inches high, may also be collected; it generally seeks the shelter of some rock; it is *Bartramia Halleriana*, and will no doubt puzzle young students not a little in their endeavours to identify it. The fruit appears to be lateral in consequence of the growth of the innovations or young shoots, which are usually solitary, but when examined at an early stage (in flower) they will be found to be truly terminal. The globose capsules of this plant are

beautifully furrowed; the whole genus is known in England as Apple moss, the capsules, although small, are round and plump—they are generally furrowed when dry. The fallen trunks of trees in this locality are covered with the club-bearing *Polyotus Magellanicus*, *Frullania proboscidiphora*, *Gottschea integrifolia* (probably a new species to science, found by Mr. Leonard Rodway), *Jungermannia cymbalifera*, *Frullania falciloba*, and other hepatics; mingled with these may be found, in patches, tufts of *Bryum bimum*, *Rhizogonium spiniforme*, *R. bifarium*, *R. sub-basilare*, and no doubt a number of other interesting plants as yet undetected.

The Silver Falls are a pleasant resort at all times, and a glimpse of the cryptogamic life around them will by no means detract from the pleasure of a visit. There is one particularly fine large moss growing there, and in many other localities about the mountain, which will certainly arrest the attention of all but the careless passer-by. I allude to *Hypnum (Ptychomnion) aciculare;* it much resembles thick green chenille chord, it is distantly branched, and the fruit-stalks shoot out most clearly from the side of the stem. Patches of hepatic, glistening like frosted silver, enrich the old trunks of forest sires as they lay here and there; these patches are composed of the curious sagey-green *Trichocolea tomentella*, the leaves are deeply cleft, so as to appear as small spikes, and are, when freshly gathered, covered with minute globules of moisture as though clothed with pearls, pearls of the purest water. The *Cyathophorum pennata* fringes the fallen tree-fern; in conjunction with *Hymenophyllum flabellatum* (a fern), it forms a royal valence to each water-worn recess, and immediately arrests the attention of the visitor to the Colony as a masterpiece, it must elicit admiration. If examined closely the fruit of the Cyathophorum will be found to spring from a tiny cup, hence its name; the fruit-stalk is very short, the capsules beautifully symmetrical. Here also will be found three or four species of *Hookeria*, *Rhizogoniums*, *Hypnums*. and *Macromitriums;* amongst *Hepaticæ*, *Polyotus*, *Mastigobryum*, *Lepidozia*, *Symphyogyna*, and the degraded *Anthoceros*, with many others. The *Macromitrium serratum* gilds the branches of the trees on which it nestles; it is lovely on the tree, it is beautiful under the microscope, and as a dried specimen it still remains charming both in colour and form. The vasculum may soon be filled in this secluded spot. Here we found *Orthotrichum luteum*, on the trees; *Distichium capillaceum*, growing at the roots of trees; *Dicranum Billardieri*, *Bryum*, *bimum*, *Ceratodon purpureus*, *Hypnum (Thuiduim) furfurosum*, *H. extenuatum*, three or four species of *Rhizogonium*, the lovely *Leptostomum Menziesii*, *Campylopus*, *Fissedens;* Hepatics of various genera, including *Marchantia polymorpha*,—the

latter easily known by its singular umbrella-like fruitstalks and expansive thallus; and others too numerous to mention.

In the fields adjoining Mr. King's land, off Cambridge-road, Kangaroo Point, *Phascum cylindricum* may be secured; also *Ceratodon, Campylopus, Funaria, Fissedens, Bartramia, Wiessia, Grimmia, Tortula, Splachnum, Bryum*, and several *Hypnums;* amongst the latter, *H. fulvastrum* is one of the most beautiful: grows in patches about six inches in diameter, and is usually yellowish, changing to light green; it is an elegant pinnately branched moss, and makes exquisite dried specimens. At the summit of Mount Rumney the *Encalypta Australis* will be found, growing in rather distant small tufts: the singularly large extinguisher-shaped calyptra will at once enable the student to recognise it. Here also the interior angles of the rocks are made beautiful by patches of *Grimmia basaltica*, the bright red peristomes of this neat plant are sure to attract attention. I will only mention one other locality, but perhaps it is the most favourable and fairest collecting-ground near Hobart; at St. Crispin's Well, near the source of the Plains Rivulet, nearly every moss that has been previously mentioned may be collected, with the addition of many more exquisite species.

In the description of species the following mosses are added to those described in "Flora Tasmaniæ."

1. Sphagnum Novo-Zealandicum, Mitt. Cat.
2. Phascum grandiglobum, Lindbg. Mitt. Cat.
3. Fissedens dealbatus. Hook. h.b. N.Z. Fl.
4. ,, asplenioides. Hook. h.b. N.Z. Fl.
5. ,, pungens. Austr. Mosses. F. v. M.
6. Blindia arcuata. Mitt. Cat.
7. Tortula Latrobeana. Mitt. Cat.
8. ,, atrovirens. Mitt. Sth. American M.
9. ,, Muelleri. Hook. h.b. N.Z. Fl.
10. Trichostomum setosum. Boswell MSS.
11. Leptangium tumidum. Mitt. Cat.
12. Grimmia basaltica. Hook. h.b. N.Z. Fl.
13. Racomitrium (Dryptodon) rupestre. Hook. h.b. N.Z. Fl.
14. ,, ,, chlorocarpon. Mitt. Cat.
15. ,, protensum. Boswell MSS.
16. Macromitrium longirostre, var. B. Hook. h.b. N.Z. Fl.
17. ,, asperulum. Mitt. Cat.
18. ,, Scottiæ. Mitt. Cat.
19. Leptostomum gracilis. Hook. h.b. N.Z. Fl.
20. ,, Menziesii. Boswell MSS.
21. Leptobryum sericeum. Mitt. Cat.
22. Orthodontium lanceolatum. Mitt. Cat.

23. Meilichoferia microdonta. Mitt. Cat.
24. Bryum campylothecium. Hook. h.b. N.Z. Fl.
25. „ chrysoneuron. Mitt. Cat.
26. Bartramia elongata. Mitt. Cat.
27. „ commutata. Mitt. Cat.
28. Funaria glabra. Hook. h.b. N.Z. Fl.
29. „ Tasmanica. Austr. Mosses. F. v. M.
30. Polytrichum (Pogonatum) tortile. Hook. h.b. N.Z. Fl.
31. „ „ Gulliveri. Mitt. Cat.
32. Cryphea parvula. Hook. h.b. N.Z. Fl.
33. „ crenulata. Mitt. Cat.
34. Isothecium fruticosum. Mitt. Cat.
35. „ augustatum. Boswell MSS
36. Hypnum fulvastrum. Boswell MSS.
37. „ amœnum. Boswell MSS.
38. „ vagum. Mitt. Cat.
39. „ oblongifolium. Mitt. Cat.
40. Rhizogonium aristatum. Mitt. Cat.
41. „ pellucidum. Mitt. Cat.
42. Hypopterygium glaucum. Mitt. Cat.
43. Hookeria denticulatum. Mitt. Cat.

1. ANDREÆA, F. Ehrhart.

Small, dark brown, growing on rocks. Key, No. 1. Named in honour of André, a Hanoverian naturalist.

1. *A. petrophila,* Ehrh. Leaves nerveless, ovate-subulate, papillose. Wils. Bry. Brit. Key, No. 1. On sub-alpine mountains.

2. *A. montana,* Mitt. Leaves ovate, slightly acuminate. On rocks, Cumming's Head.

3. *A. acuminata,* Mitt. Leaves sheathing, ovate-lanceolate, lower margins minutely crenulate. On rocks, Mt. Wellington.

4. *A. nitida,* J. Hook. and Wils. Leaves nerveless, oblong-ovate, obtuse, shining. Western Mountains.

5. *A. subulata,* Harvey. Leaves with broad nerve, ovate-subulate, falcate. Mt. Wellington.

2. SPHAGNUM, C. Linnæus.

The name is from Pliny; he used it to denote moss-like growths on trees. Key, No. 4. In bogs.

A. Branches with one or two cortical layers of cells.

1. *S. molliculum,* Mitt. Leaves elliptic-oval, apex sub-truncate, minutely denticulate. Cheshunt.

2. *S. cymbifolioides,* C. Muell. Stem leaves oval; branch leaves truncate, toothed. Cheshunt.

3. *S. contortum,* Wils. Leaves ovate-lanceolate, acute, sub-coriaceous. Key, No. 4. In bogs, Mt. Wellington. Var. 2, *laxum*; var. 3, *scorpioides*; var. 4, *intermedium.*

4. *S. compactum,* Bridel. Leaves ovate-oblong; apex truncate, denticulate. In bogs, Huon River. Var. γ, Huon River.

B. Branches with three or more cortical layers of cells, without spiral fibres.

5. *S. cymbifolium,* Dill. Cells of branches with spiral fibres. Wils. Bry. Brit. In swamp, New Norfolk.

6. *S. australe,* Mitt. Leaves of branches ovate, obtuse. Near Huon River.

7. *S. confertum,* Mitt. Leaves of branches ovate; apex truncated, toothed. Near Cumming's Head.

8. *S. Novo-Zealandicum,* Mitt. Habit compact of S. cymbifolium, cortical cells without spiral fibres; cauline leaves obovate-lingulate, obtuse, denticulate. Branch leaves ovate-acuminate. Mitt. Aust. Cat.

3. PHASCUM, Linnæus.

Minute mosses growing on earth, named in allusion to the bladdery appearance of the fruit. Key, No. 2.

1. *P. (Ephemerum) cristatum,* Hook. and Wils. Leaves lanceolate, deeply toothed; capsule immersed; calyptra campanulate. Cheshunt.

2. *P. (Astomum) cylindricum,* Taylor. Tufty; capsule elliptic, apiculate; fruitstalk short; operculum, persistent; calyptra cucculate or conico-campanulate. In fields, Kangaroo Point.

3. *P. (Acaulon) apiculatum,* Hook. fils. et Wils. Bud-form. Leaves obovate, acuminate, concave, apiculate, the tip apparently secund. Cheshunt. Var, *turgidum* Cheshunt.

4. *P. (Pleuridium) gracilentum,* Mitt. Stem, $\frac{1}{4}$in. high. Upper leaves much attenuated. Fruitstalk short. Key, No. 2. West side of Tower Hill, Cheshunt.

5. *P. (Pleuridium) tenellum,* Mitt. Pale brown, fragile texture. Capsule oval, shortly pedicellate, closely corresponding with *P. nitidum* (Wils. Brit. Bry.). Cheshunt.

6. *P. (Pleurophascum) grandiglobum,* Lindbg. Description not available.

4. BRUCHIA, S. E. Bridel.

A gemmiform plant, growing on clayey banks, named in honour of Bruch. Key, No. 3.

1. *B. minuta,* Mitt. Leaves lanceolate, minutely serrulate above. Capsule entire, apophysate. Key, No. 3. Sides of ditches, Cheshunt.

5. GYMNOSTOMUM, Hedwig.

Usually growing on moist rock. Name, from *γυμνος*, naked, and *στομα*, mouth. Key, No. 13.

1. *G. calcareum,* Nees and Hornsch. Stem $\frac{1}{8}$ to $\frac{1}{4}$in. high ; leaves spreading, linear-lanceolate, margins flat. Key, No. 13. On rocks, North-West Bay.

2. *G. bicolor,* Hampe. Leaves distant, recurved, linear, obtusely apiculate, papillose at the back, slightly denticulate at the apex. On the ground amongst lichens and other mosses.

6. WEISSIA, Hedwg.

Named in honour of Weiss, a cryptogamic botanist, of Gottingen. Key, No. 25. In fields, on banks, and shady rocks.

1. *W. flavipes,* Hook. *f.* and Wils. Leaves narrow lanceolate, margin nearly flat. Teeth perforated. Key, No. 25. Gullies, Mt. Wellington, Kangaroo Point.

2. *W. contraversa,* Hedwig. Leaves lanceolate, margin involute. Teeth nearly entire. Wils. Bry. Brit. Cheshunt. Kangaroo Point.

3. *W. microcarpa,* Hook. *f.* and Wils. Leaves carinato-concave. Teeth slightly divided at apex. Kangaroo Point.

7. SYMBLEPHARIS, Camille Montague.

So named in allusion to the teeth of the peristome conniving. On trees and stones, common.

1. *S. perichætialis,* Wils. Perichætial leaves very long; lid as long as capsule; calyptra twice as long. Key, No. 26.

8. FISSEDENS, Hedwg.

So named in allusion to the divided teeth of the peristome. In damp places. Key, No. 56.

1. *F. adiantioides,* Hedwig. 1-2in. high. Fruitstalk lateral. Wils. Bry. Brit. Key, No. 58. On damp slopes of Mount Wellington.

A. Margin of leaf thickened and hyaline.

2. *F. dealbatus,* Hook. *f.* and Wils. $\frac{1}{6}$in high, leaves linear-oblong, acuminate, entire, nerveless. Hook. Handbook, N.Z., Fl. On wet rocks.

3. *F. rigidulus,* Hook. *f.* and Wils. 1 to 2in. long. Leaves ovate-lanceolate, acute; nerve continuous. On stones in running water, Mount Wellington.

4. *F. brevifolius,* Hook. *f.* and Wils. Stems $\frac{1}{2}$in. high. Leaves on shoots, ovate-acuminate, entire, nerved to the apex. Capsule sub-erect or inclined. Lid, short beak. Var. *B. floribundus*, leaves longer, curled when dry. Shady banks, New Norlolk. *F. scalaris,* Mitten.

5. *F. incurvis,* Hook. Fruiting plant $\frac{1}{2}$in. in length; leaves lanceolate, nerve continuous. Capsule cernuous; lid conico-acuminate. St. Patrick's River.

6. *F. vittatus,* Hook. *f.* and Wils. Stem two lines high. Leaves ovate-ligulate, undulate. On the ground, Circular Head.

7. *F. Taylori,* C. Mueller. Stem, one line long. Leaves of fertile plant amplectant, acuminate. Seta flexuose. Capsule oval, inclined. Clay banks, Mt. Wellington. *F. pygmæus*, Taylor..

B. Margin of leaf not thickened and hyaline

8 *F. pungens,* C. Muell. and Hampe. Similar to F. incurvis, with leaves immarginate. F. V. M. Austr. Mosses; incurvis, var. Wils. On the ground in shady forests.

9. *F. asplenioides,* Swartz. Stem, ½ to 1in. high; leaves crisped when dry, ligulate, obtuse, crenulate, nerve not continuous. Seta stout. *F. ligulatus*, Hook *f.* and Wils. Fl. N.Z. Hook, Hand-book, N.Z. Fl.

10. *F. oblongifolius,* Hook *f.* and Wils. Stems, ⅓-⅔in. high; leaves not crisped when dry, linear-lanceolate, acuminate, apex crenulate, nerve not continuous. Seta slender, gracefully curved, capsule very small. On rocks, N.W. Bay.

11. *F. pallidus,* Hook *f.* and Wils. Stems, ¼in. decumbent; leaves flabellately spreading, pale yellow-green, linear lanceolate, acute, entire, nerve continuous. Lid longer than capsule. Key, No. 56. On the ground.

12. *F. tenellus,* Hook *f.* and Wils. Minute. Leaves linear lanceolate, crenulate, nerve excurrent. Lid long beaked. Calyptra papillose, mitriform. On the ground.

13. *F. strictus*, Hook *f.* and Wils. Stem ½in. high. Leaves linear lanceolate, entire, nerve almost evanescent. Fruitstalk short, thick. Capsule turbinate; lid rostrate; calyptra small, mitriform. Yorktown Rivulet.

14. *F. integerimus,* Mitten. Stem ½in. high; fruitstalk scarcely two lines long. Similar to *F. oblongifolius*, but leaves entire, yellowish-brown above, black below. Cheshunt.

9. LEUCOBRYUM, Hampe.

The name refers to the mosses being of a whitish colour. Key, No. 35.

1. *L. candidum,* Hampe. Stem ½ to 2in. high. Leaves of spongy texture, falcate, recurved, ovate, lanceolate. Fruit on short lateral branches. Capsule cernuous, strumose, grooved. At the roots of trees in swampy places.

10. DICRANUM, Hedwg.

So named in allusion to the teeth of the peristome resembling a forked instrument. A very large handsome genus abundant in woods. Key, No. 36.

A. Leaves entire.

1. ***D. Sieberianum,*** Hornsch. Stems ½-1in. high. Leaves yellowish, ovate-lanceolate, piliferous, margin entire, white. Fruitstalk on short lateral shoot. Hook. Handbook N.Z. Fl. Key, No. 36. *Leucodon pallidum*, Hook. Musci-Exot. On wet rocks.

2. ***D. Tasmanicum,*** Hook. *f.* Stems 1-2in. high. Leaves pale or dark-green or reddish, lanceolate oblong, obtuse, channelled, quite entire, nerve vanishing. Fruitstalk ½in. long. Capsule erect, turbinate, often 3-fid. *Dichodontium*, Schimper. On wet cliffs, Mt. Wellington.

3. ***D. sphagni,*** Wahleht. Stem 1in. long. Leaves yellowish, subulate, lanceolate, entire; nerve strong, excurrent.

4. ***D. Starkii,*** Web. and Mohr. Stems 1-3in. long. Leaves falcato-secund, subulate-setaceous, not crisped when dry, entire, strong nerve. Capsule arcuate, strumose, striated, annulus double. Wils. Brit. Bry. Brown's River.

5. ***D. (Leptotrichum) ferrugineum,*** Mitten. Stems ½-1in. high, dull ferruginous green, interwoven with radicles; leaves oval-oblong, attenuated, open, entire, nerve percurrent. Fruitstalk three lines long. Capsule sub-globose, erect. On the ground, Western Mountains.

6. ***D. angustifolium,*** Hook *f.* and Wils. Stems 1-1½in. high. Leaves long, lanceolate, setaceous, entire, apex flexuose when dry, nerve narrow, excurrent. Livid hue. In bogs, Mt. Wellington.

B. Leaves serrulate.

7. ***D. Billardieri,*** Bridel. Stems, 2-4in. high. Leaves, ¼in. long, yellow-green, ovate-lanceolate, acuminate, concave, not striate, apex serrulate, nerve slender. Capsule curved, strumose. On the sides of Mount Wellington.

8. ***D. angustinerve,*** Mitten. Similar to *D. Billardieri*, but with perichætial leaves furnished with a bristle-like point. On dead wood.

9. *D. pungens,* Hook. *f.* and Wils. Stem frequently 6in. high. Leaves secund, open, linear-lanceolate, convolute, apex carinate, serrulate, slender nerve. *D. Nov. Hollandiæ,* Hornsch. Among rocks and running water.

10. *D. setosum,* Hook. *f.* and Wils. Stems brittle, 1-4in. long, yellow, glossy. Leaves ½in long, fragile, very long lanceolate and setaceous, serrulate, nerve broad, excurrent in long setæ. Perichætial leaves short, Capsule sub-erect; lid with long beak. Calyptra pale brown, red at apex. Hook. Handbook, Fl.N.Z. Springs, Mount Wellington.

11. *D. Menziesii,* Taylor. Stems covered with matted whitish fibrils. Leaves secund, straight when dry, subulate-lanceolate and serrulate at the base, very long setaceous point, nerve solid; perichtæial shorter. Fruitstalk hardly longer than the leaves. Substrumose capsule with long beak. *D. brachypelma,* C. Muell. Var. B. *rigidum,* dark green, more robust. Dense forests, River Acheron.

C. Leaves spinulose, serrate.

12. *D. dicarpon,* Hornsch. Stems 1-2in. high, covered with matted fibrils. Leaves squarrose, linear-cuspidate, striate, margin and back spinulose-serrate, nerve solid. Fruitstalks two or more together, sheathed by long perichætial leaves. Lid with long beak. *D. leucolomoides,* C. Muell. Var. B. *spinosum,* a larger variety, with numerous longer setæ. In dense woods, New Norfolk.

13. *D. robustum,* Hook *f.* and Wils. Stems 3-5in. long, robust. Leaves sub-secund, long subulate-lanceolate, into almost capillary points, spinulose-serrate above nerve excurrent. Capsule cylindrical, inclined, substrumose; lid with long beak. Cheshunt.

11. BLINDIA, Bruch and Schimper.

Named in honour of Blind, of Munster. Key, No. 27. On moist Alpine rocks.

1. *B. acuta,* Br. and Sch. Stems tufted, ½-3in. high. high. Leaves sub-secund, rigid, glossy, oblong from a concave base, then linear lanceolate, nerve excurrent and thick. Perichætial leaves sheathing below, open above. Capsule erect, globose, pyriform on short fruitstalk. *Weissa acuta,* Hedwg. Key, No. 27. Var. B, *curviseta.* Capsule nearly round, seta arcuate, thick. On stones, rivulet near Cumming's Head.

2. *B. arcuata,* Mitten. Stems ½-1in. long. Leaves linear, slightly glossy. Fruitstalk 1½ lines long, curved. Capsule drooping, oval; after the lid has fallen away the capsule assumes a cup form. Mitten Aus. Cat., Mitt. Musc. Austro-Americana.

3. *B. tenuifolia,* Hook *f.* and Wils. Dicranum. Stems 1in. high. Leaves brownish, black below; secund, falcate, narrow elliptic below, gradually long and slender, capillary-subulate, margin incurved, nerve indistinct, perichætial sub-orbicular, convolute, nerve long excurrent. Capsule erect on thick short fruitstalk, oval, turbinate; lid subulate. Mitt. Sth. Amer. Mus. Rock behind Cumming's Head, Western Mtns.

12. CAMPYLOPUS, Bridel.

From *καμπυλος*, bent, and *πους*, a foot, alluding to the bent fruitstalk. Key, No. 37. On logs, and in swamps.

A. Leaves with white reflexed hair points.

1. *C. introflexus,* Hedwg. Leaves, base broad, concave, with a pellucid margin, suddenly contracted into a white toothed hair point. Capsule obovate, unequal; lid conical. Abundant on logs, and on the ground.

B. Leaves with straight hair points.

2. *C. torquatus,* Mitten. Leaves of lax and spongy texture, base ovate-lanceolate, narrowed into a long subulate, setaceous, white spinulose point. Fruitstalk twisted. Capsule pyriform. Key, No. 37. On the slopes of Mt. Wellington.

3. *C. clavatus,* Brown. Stems dichotomously branched; leaves golden yellow, lanceolate, suddenly acuminate into white, straight, short hair points.

4. *C. insititius,* Hook. *f.* and Wils. Leaves with a short pellucid base, erect, open, slightly recurved, when dry incurved, lanceolate, subulate, canaliculate, hair-pointed. Capsule nearly elliptic, equal, scarcely strumose. Calyptra, deeply fimbriated. About Brown's River, common.

C. Leaves subulata-setaceous.

5. *C. capillatus,* Hook. *f.* and Wils. Stems 1-2in. or more. Leaves bright green, glossy, ovate-lanceolate at the base, then subulate-setaceous, areolæ at the base, rectangular and pellucid. Capsule symmetrical; calyptra shortly fimbriated. Brown's River, with the preceding species.

D. Leaves obtuse.

6. *C. bicolor,* Hornsch. Leaves, lower black, upper glossy green, subulato-lanceolate, obtuse, concave at the apex, without hair points. Nerve broad. Hook. Handbook Fl. N.Z.

13. TREMATODON, A. and L. C. Richards.

So named in allusion to the rough and unequally divided teeth of the peristome. Key, No. 38. With narrow leaves, and the habit of Dicranum

1. *T. flexipes,* Mitten. Stems very short. Leaves patent, lanceolate-subulate, entire; nerve broad. Fruitstalk short, flexuose. Capsule sub-erect, equi-long with neck, teeth red, cleft; lid with curved beak. On the ground, near Cumming's Head, Western Mountains.

"The nerve occupies the whole of the upper three-fourths of the leaf, the seta flexuose, and the peristome with distinctly cleft teeth."—Mitten.

14. DESMATODON, Bridel.

Banded tooth; the peristome teeth are sometimes joined by one or two bars. When highly developed, scarcely distinguishable from Tortula. Key, Nos. 15 and 29.

1. *D. nervosus,* Bruch and Schimper. Stems $\frac{1}{4}$in. high. Leaves yellow-green, spreading, ovate-oblong, apiculate, concave, margin reflexed, nerve thickened upwards, excurrent. Fruitstalk $\frac{1}{10}$-$\frac{1}{4}$in. long. Capsule ovoid, erect, teeth sometimes absent; lid hardly beaked. Wils. Bry. Brit. On dry earth, banks, etc.

15. TORTULA, Schreber.

Twisted. The peristome teeth are twisted to the left. Key, No. 33. Ubiquitous.

A. Nerve of the leaf produced into a white hair like point.

1. *T. Muelleri,* Br. and Schimp. Stems elongated, covered with root fibres. Leaves crowded, erecto-patent, straight, imbricate when dry, oblong-oval, obtuse, concave; margin reflexed; nerve purple red, excurrent into a roughish hair point. Fruitstalk long, purplish. Capsule cylindric, curved. Hook. Handbook N.Z. Fl. *T. antarctica,* Hampe; *Syntrichia princeps,* De Notaris; *T. cuspidata* and *T. rubella* referred by Mitten to this common species. Mt. Rumney, generally diffused.

2. *T. antarctica,* Hampe. Synoicous, leaves loosely twisted when dry, lanceolate-ligulate, obtuse, nerve red, fawn coloured, more lax and more twisted when dry than in *T. Muelleri.* Around Hobart, Port Sorell.

3. *T cuspidata,* Hook. *f.* and Wils. The red nerve produced into a rather long, smooth point, wider above than *T. antarctica,* areolation less opaque, tinged with red. Leaves narrower than *T. Muelleri,* less appressed when dry. Key, No. 33. Moist earth, in woods on Mt. Wellington.

4. *T. rubella,* Hook. *f.* and Wils. Stems short, sparingly branched; leaves oblong, sub-spathulate, obtuse, red nerve excurrent into rather rough hair point. On banks, Mt. Rumney.

5. *T. papillosa,* Wils. Bryol. Brit. Stems short; leaves dull-green, spreading, erect when dry, obovate, sub-acute, very concave, margin flat, short hair point, strongly involute when dry, papillose at the back, and on the thick spongy gemmiparous nerve. On trees and swampy places.

B. Nerve of the leaf excurrent, not white at the apex.

6. *T. torquata,* Taylor. Stems short; leaves closely spirally twisted when dry, lanceolate, acuminate, margin entire, revolute. Nerve stout, scarcely excurrent. Fruitstalk pale red, slender, flexuose. Capsule erect, oblong ovate. Hook. Handbook N.Z. Fl. Cheshunt.

7. *T Australasiæ,* Hook. *f.* and Wils. Stems short, simple, $\frac{1}{4}$ to $\frac{1}{3}$in. long. Leaves reddish, spreading, slightly recurved, twisted and crisped when dry, subligulate linear, or lanceolate, acute or obtuse, nerve red, running to the apex. Capsule cylindric-ovoid, teeth oblique but hardly twisted; lid with short beak. *Trichostomum,* Hook. and Grev. *T. fusescens,* Hook. f. and Wils. *T. rufiseta,* Taylor. Hook. Handbook N.Z. Fl. Kangaroo Point, on the ground.

8. *T. Knightii,* Mitten. Stems $\frac{1}{4}$-$\frac{1}{3}$in. long. Leaves pale yellow green, crisped when dry, linear-lanceolate from an oblong, broader, transparent base; very acuminate; margins quite entire, undulate; nerve slender excurrent. Fruitstalk slender, pale. Capsule cylindric.. Hook. Handbook N.Z. Fl. Wellington Falls, Mt. Wellington.

9. *T. calycina,* Schwægr. Very short stem, slightly branched. Leaves yellow green, lanceolate, sub-undulate, margin flat, nerve thick, perichætial long, sheathing. Fruitstalk ½ to 1½in. long, red, yellow above. Capsule small, elliptic-oblong sub-erect; lid with a long, slender, subulate beak. Hobart, on stones and at the foot of trees.

10. *T. pungens,* Hook. *f.* and Wils. Stems rather long, slightly branched. Leaves curled and twisted when dry, lanceolate-ligulate, margin revolute, papillose at the back, nerve strong, ending in smooth short point; perichætial leaves longer. Capsule cylindric, curved. *T. luteola,* Mitten; *T. Tasmanica,* Hampe. Common on rocks, Grasstree Hill.

11. *T. recurvata,* Hook. Stems short. Leaves erect, ligulate-lanceolate, slightly concave, margin revolute, nerve thick, excurrent; seta long; capsule oblong, nearly erect; lid conico-subulate. Nearly allied to *Desmatodon nervosus,* twice as tall, and more slender habit. On wet ground, Mt. Dromedary.

12. *T. scabrifolium,* Mitt. The leaves furnished with a thick purple nerve with hyaline ciliiform papillæ, rough, shortly apiculate. Capsule erect on short red flexuose fruitstalk, narrow, cylindric, oblong, peristome a basilar membrane, rather long, tesselated. Mitt. Sth. Amer. Mosses.

13. *T. atrovirens,* Sm. Eng. Bot. t. 2015. Stems short. Upper part of leaves open, incurved, oblong, acute, canaliculate, nerve thick, shortly excurrent, margin reflexed. Capsule on yellowish fruitstalk, oval or cylindrical, erect; lid conical, oblique. Teeth unequal, papillose, forming a short membrane at the base. Mitten's Sth. American Mosses. Kangaroo Point.

C. Calyptra, mitriform.

14. *T. minoides,* Schwægr. Leaves yellowish, crisped, of firm texture, spreading, loosely imbricate, undulate, ovate-lanceolate, acuminate; margins pellucid, often gemmiparous at the apex. On logs, in copses, Mt. Wellington.

15. *T. Latrobeana,* C. Muell. Description not available.

16. TRICHOSTOMUM, Bridel.

Hairy mouth, in allusion to the 32 filiferous teeth of the peristome. Key, No. 32. Hilly districts.

A. Leaves entire.

1. *T. laxifolium,* Hook. *f.* and Wils. Stems short, $\frac{1}{4}$in. long, simple. Leaves yellowish, distant, setaceous subulate, lower $\frac{1}{3}$ ovate, quite entire, nerve solid. Fruitstalk 1in. long, red, capsule sub-erect, oblong, gibbous; lid conical, subulate. *Dicranum flexifolium.* Hook. Musc. Exot. On moist clayey ground.

2. *T. setosum,* Hook. *f.* and Wils. Stems $\frac{1}{4}$ to $\frac{1}{2}$in. high. Leaves pale yellow, lower ones reddish, crowded, setaceo-subulate from an ovate lanceolate sheathing base, entire, sharply keeled, nerve broad. Fruitstalk pale; capsule oblong, oblique, annulus distinct; lid with slender beak, half as long as capsule. On banks, Huon Road.

B. Leaves granulose serrate.

3. *T elongatum,* Hook. *f.* and Wils. Stems $\frac{3}{4}$ to 1in. long, simple. Leaves spreading; lower, elliptic oblong; margin pellucid, suddenly contracted to a long subulate keeled point, subserrate. Fruitstalk 1in. long, red, capsule erect, pale brown, cylindric, long; lid conico-subulate, half as long as the capsule. Mt. Wellington, Grass Tree Hill.

C. Leaves denticulate.

4. *T Oldfieldii,* Mitten. Stems $\frac{7}{8}$in. long. Leaves oblong-ovate from a wide base, erect, spreading, subulate, apex sparingly denticulate, nerve occupies the upper part of the leaf; perichætial, bases longer and wider. Fruitstalk long, capsule cylindrical, arcuate, male flowers gemmiform, in the axils of the leaves of the stem. In size and appearance near to *Leptotrichum affine,* C. Muell., but with leaves twice as wide at the oblong base, and thence subulate. On the ground.

5. *T cylindricarpum,* C. Muell. Stems $\frac{1}{4}$ to 1in. high, yellowish green, crowded, robust, short. Leaves long setiform, when dry slightly curled and secund, narrow from a long sheathing base, apex attenuated, denticulate, nerve occupying the whole of the upper portion of the leaf; perichætial leaves long, sheathing. Fruitstalk long, capsule erect, narrow, perfectly cylindrical, slightly curved. Among rocks, Cataract, Launceston.

6. *T. australe,* Mitten. Stems 1 to 4in. high. Leaves lurid yellow green, lower half sheathing, linear-oblong, upper setaceous, subulate, denticulate; perichætial elongate, convolute. Fruitstalk pale brown, ½in. long. Capsule ovoid, erect, brown, teeth short; lid more than half as long as the capsule. *Lophiodon longifolius* and *Didymodon longifolius,* var. 3 Fl. Antarctica. *Trichostomum longifolium* and *Distichium capillaceum,* Fl. N.Z. Hook. Handbook Fl. N.Z. Key, No. 32. At the base of Mt. Wellington.

17. DIDYMODON, Bruch and Schimper.

Twin tooth. Notwithstanding the name, the teeth are not obviously united by a basilar membrane. Wils. Bryol. Brit. Key, No. 30. Growing on the ground and on rocks.

1. *D. papillatus,* Hook *f.* and Wils. Stems 1in. long, rigid, slightly branched; branches filiform, erect. Leaves yellowish, three-farious, spreading, recurved, erect when dry, and sub-secund, ovate-lanceolate, acuminate, keeled, entire, papillose both sides, nerved. Fruitstalk ½-¾in long. Capsule erect, narrow oblong, pale, contracted at the mouth, teeth irregular, lid conical, subulate. *Zygodon tristichous,* C. Muell. *Zygodon Preissianus,* Hampe. *Leptodontium papillatum.* Mitt. Cat. On the ground around Hobart, the Hummocks.

18. DISTICHIUM, Br. and Schimper.

In allusion to the distichous or tristichous leaves. Key, No. 21. At the roots of trees, on old logs.

1. *D. capillaceum,* Br. and Sch. Stems forming dense and wide-spreading tufts, 1 to 4in. high. Leaves setaceous from a lanceolate sheathing base, quite entire. Capsule erect, ovoid oblong or sub-cylindric; teeth narrow, with distant articulation, irregularly two-cleft. Wils. Bry. Brit. On the slopes of Mt. Wellington.

19. CERATODON, Bridel.

Horn-tooth; the teeth of the peristome have some resemblance to ram's horns. Key, No. 34. Abundant.

A. Purple fruitstalk.

1. *C. purpureus,* Bridel. Stems short, dichotomously branched. Leaves dull green, spreading, oblong lanceolate, keeled, papillose on the back, margins recurved, somewhat twisted when dry, nerve strong, excurrent; perichætial, larger, sheathing, acuminate. Fruitstalk purple. Capsule nearly erect, oblong, slightly incurved, striate, nearly horizontal when dry. Teeth two fid., edges pale, lid conic. Key, No. 34. Moist burnt ground, rocks and stones, abundant.

B. Yellowish fruitstalk.

2. *C. stenocarpus,* Br. and Schimp. Habit of the preceding species. Fruitstalk yellowish, capsule more or less cylindrical, cernuous, angular, seemingly strumose, peristome of short narrow brown teeth. On the ground in the bush.

20. HEDWIGIA, F. Ehrhart.

Named in honour of Hedwig. Loosely tufted and creeping Key, No. 8 and 9. On Alpine rocks, near waterfalls.

1. *H. ciliata,* Ehr. 1-2in. long, forming loosely tufted patches. Leaves yellowish, imbricate when dry, ovate lanceolate, with erose diaphanous points. Perichætial larger, apices ciliate. Capsule immersed, sub-sessile, lid plain, calyptra sub-pilose. Key, No. 8. On the summit of Mount Wellington.

2. *H. imberbis,* Br. and Schimp. Leaves ovate acuminate, margin revolute; perichætial, lanceolate-acuminate, sheathing, capsule sub-globose, on short pedicel, immersed. Lid conical; calyptra naked. Var. *B. Drummondii* leaves less acuminate, lid beaked. On dry rocks.

21. BRAUNIA, Schimper.

Named in honour of A. Braun, Professor of Botany, Berlin. Key, No. 10. On moist rocks.

1. *B. Humboldtii,* Schimp., *Hedwigia,* Hook. Stems sub-erect, 2-6in. high. Leaves obovate, acuminate, with long hair points, coriaceous; perichætial larger, sheathing, reddish, glossy. Fruitstalk $\frac{1}{3}$ to $\frac{1}{2}$in. long. Capsule sub-globose, sulcate; lid beaked. Calyptra cucculate. On moist trap rocks and in bogs, Mt. Wellington.

22. LEPTANGIUM, Montague.

Slender capsule. Minute, tufted, growing in vegetable soil. Succulent subterraneous stem and short branches. Key, No. 11.

1. *L. repens,* Mitten. *Hedwigia* in Fl. Tasm. *Anœctangium* in Musc. Exot. Stems very minute, $\frac{1}{8}$-$\frac{1}{4}$in. high. Leaves on the barren stems spreading, nearly orbicular; on the fertile, larger, whitish, imbricating, ovate, narrowed into a slender acuminate point, quite entire. Capsule immersed, mouth wide, closed by a horizontal membrane; spores large. Calyptra conical, small. Key, No. 11. North side of Cataract, Launceston.

2. *L. tumidum,* Mitten. Leaves oblong-oval, cochleariform-concave, margin recurved, acute or short narrow apiculate, no nerve. The fruit being absent, the genus is doubtful. Mitten Austr. Catalogue.

23. GRIMMIA, Ehrh.

Named in honour of Grimm, a German botanist. On rocks.

A. Schistidium. Capsule on very short fruitstalk, hidden among the leaves.

1. *G. apocarpa,* Hedwg. Nearly black, $\frac{1}{2}$ to 3in. long. Leaves ovate-lanceolate, apiculate or obtuse, margin reflexed, nerve vanishing below hyaline tip. Capsule elliptic, immersed, without ring. Key, No. 19. Foot of Mount Nelson.

B. Grimmia. Capsule on a short curved fruitstalk.

2. *G. pulvinata,* Smith. Hoary tufts; leaves oblong-lanceolate, keeled above, terminated abruptly by a white hair, margin entire, recurved, nerve varnishing. Capsule turned downwards, ovoid, furrowed. Double ring, lid beaked, calyptra mitriform. Var. *B. Africana,* lower, capsule shorter, lid conic, very short mammilate. On trap rock.

3. *G. tricophylla,* Greville. Stems short, forming loose tufts. Leaves yellow green, linear-lanceolate, narrowed into a white diaphanous hair point, flexuous, crisped when dry, nerve vanishing; capsule pendulous, ovoid, striated, angular when dry, annulus broad, teeth two-fid, lid conical, beaked. Mt. Wellington, on rocks.

4. *G. basaltica,* Mitten. Small hoary tufts. Leaves spreading, oblong-lanceolate, acuminate with a hyaline hair point, keeled by the percurrent nerve, perichætial with a much longer hair point. Fruitstalk curved. Capsule ovoid-globose, plicate when dry. Teeth red, perforated, sub-entire, reflexed when dry, lid short, conic-acuminate. Inflorescence monoicous. Hook., Handbook N.Z. Fl. Mount Rumney, on rocks.

5. *G, funalis,* Br. and Schimp. *Grimmia Schultzii,* Bridel. Stems tufted; leaves crowded, lanceolate, sub-secund, gradually tapering into a long rough diaphanous point, their margins recurved. Fruitstalk curved, shorter than the perichætium. Capsule shortly elliptic or obovate, furrowed, annulus very large, teeth of the peristome long, deeply bifid. Wils. Bry. Brit.

C. Orthogrimmia, Capsule on straight pedicel.

6. *G. leucophæa,* Greville. Stems rather short, tufted; leaves spreading, erect, imbricated when dry, ovate-oblong, concave, with long hair points, margin plane; capsule exserted, erect, elliptical or oblong; lid short, conico-rostellate; annulus large, dehiscent, teeth bifid, perforated. Wils. Bry. Brit. On moist rocks, near Hobart.

24. PTYCHOMITRIUM, Bruch and Schimper.

Name from πτυχη, a plait, and μιτριον, calyptra, in allusion to the furrowed calyptra. Key, No. 17. On rocks in mountainous places.

A. Leaves entire.

1. *P. acutifolium,* Hook. *f.* and Wils. Low, thick branched. Leaves dense, open, incurved, when dry twisted, lanceolate-subulate, acute, solid nerve, areolation pellucid at the base. Capsule large, erect, oval, ringed. Teeth short, partly divided, connected by a basilar membrane. On banks and trap rocks near the Derwent.

B. Leaves serrate.

2. *P serratum,* Mitten; *Glyphomitrium Mittenii,* Jaeger. Leaves open, recurved, ovate at the base, gradually acuminate, serrate. Capsule oval, cylindrical; lid subulate, nearly as long as the capsule; teeth rather long, red, uneven, deeply divided, approximating in pairs. Key, No. 17. On rocks, Cataract, Launceston; rocks, Proctor's Road, near Hobart.

25. RACOMITRIUM, Bridel.

Torn Calyptra. The calyptra is fringed. Key, No. 20. On moist rocks in mountain districts.

A. Dryptodon. Dichotomously branched, young shoots simple, reaching an equal height.

1. *R. crispulum,* Hook. *f.* and Wils. Loosely tufty, stems 1-1½in. high. Leaves erecto-patent, sub-recurved, ovate-oblong, acuminate, keeled, entire; apex sub-diaphanous, nerve percurrent, perichætial shorter. Fruitstalk very short, lateral by growth of side shoots. Capsule elliptic-oblong, erect or inclined, lid conico-subulate, half as long as capsule, teeth two fid, reflexed when dry. Var. 1. Leaves shorter, destitute of a slender point. Var. 2. Leaves longer, destitute of a slender point. On trap rocks Glen Leith, rare. Rocks, North and South Huon.

2. *R. chloracarpa,* Mitten. Similar to the preceding species, but with leaves with sub-oval base, obtuse, apiculate. Hook. Handbook N.Z.

3. *R. rupestre,* Hook *f.* and Wils. Densely tufted, 1-2in. long. Leaves sub-spirally imbricate when dry, ovate-lanceolate or ovate-acuminate; lower sub-squarrose, upper recurved, keeled, margin sub-recurved, when dry more or less incurved and twisted; nerve scarcely continuous, red; perichætial broader, elliptic-oblong, obtuse. Fruitstalk very short, twisted when dry. Capsule small, erect, elliptic-oblong, red-brown, mouth contracted; teeth red, spreading when dry. Lid with a very slender beak, nearly as long as the capsule. Hook. Handbook N.Z. Fl. Moist rocks on the mountains.

4. *R protensum,* Braun. Loosely tufted, leaves light green, spreading all round or sub-secund, appressed when dry, rather rigid, elongate-lanceolate, not diaphanous at the summit; nerve strong, percurrent; perichætial, somewhat sheathing. Fruitstalk pale, ½in. long. Capsule sub-cylindrical, pale brown, thin walled; teeth long, irregularly split to the base; lid usually as long as the capsule, beaked. Wils. Bry. Brit. On Mount Wellington.

B. RACOMITRIUM, irregularly branched, branches short, young shoots not reaching to an equal height.

5. *R. symphyodon,* MITTEN. Elongate, rather short branches with bunches of leaves; leaves spreading, sub-secund, erect when dry, ovate-lanceolate, acuminate, with hyaline points, margin recurved below, perichætal acute. Fruitstalk yellow, short; capsule cylindric, mouth small; teeth stout, with transverse connecting bars. Calyptra rather rough at the apex. Key, No. 20. On rocks, Mount Wellington.

6. *R. heterostichum,* HEDWG. Stems with short lateral branches of unequal height; leaves spreading, subsecund, lanceolate-acuminate, ending in a flaccid hyaline hair. Capsule elliptic-cylindrical and obovate-oblong; teeth deeply bifid. Var. B. *alopecurum,* leaves with shorter hair points, less capsule, with shorter fruitstalk. Var. γ, *gracilescens*, leaves obtuse. On stones and rocks, abundant.

7. *R. lanuginosum,* HEDWG. Stems wide, fasciculately branched, leaves erecto-patent, recurved, lanceolate-acuminate, apex erose-dentate, produced into a long hyaline hair. Minute ovoid capsule on very short rough fruitstalk, teeth bipartite, filiform. Var. *pruinosum*, apices of leaves strongly inciso-serrate, whitish. Summit of Mt. Wellington.

26. ENCALYPTA, SCHREBER.

Veiled, alluding to the calyptra entirely covering the capsule. Key, No. 6. On Alpine heights.

A. Tip of calyptra papillose.

1. *E. vulgaris*, HEDWG. Leaves ligulate, nerve vanishing. Capsule generally gymnostomous, the entire base of the calyptra reaching to the neck of the capsule. Var. B. *obtusa.*

B. Tip of calyptra smooth.

2. *E. australis,* MITTEN. Similar to *E. vulgaris*, leaves ligulate below, upper oblong-spathulate, rather obtuse, margin papillose, scarcely denticulate, rough at the back below the apex. Capsule with lid equal in length, Calyptra smooth at the tip. Key, No. 6. Differs from *E. vulgaris* in the less rounded apices of its leaves and smooth point of the calyptra.

In Mitten's Catalogue of Australian Mosses, *E. vulgaris*, *E. Australis*, and *E. ciliata*, are referred to *E. Tasmanica*, Hampe and C. Muell. in Linnæus, 1853.

27. MACROMITRIUM, Bridel.

Long calyptra. Common on trunks of trees. Key, Nos. 7, 16, and 43.

B. Calyptra glabrous, lid long-beaked.

1. ***M. longirostre,*** Schwægr. Branches erect, 1in. high, crowded. Leaves bright yellow, red, or bronze, lower black, twisted when dry, linear lanceolate, very acute, with two parallel lines, one on each side the solid stout nerve, margins recurved, nerve reddish. Fruitstalk stout, short, $\frac{1}{3}$ to $\frac{1}{4}$in. long, black. Capsule sulcate, elongate, narrow, almost linear-oblong, gradually narrowed into the stout fruitstalk; peristome single, lid with slender straight beak, calyptra glabrous, fimbriated half-way up. Var. *B. acutifolium* leaves more acuminate, with a sub-excurrent nerve. Hook. Handbook N.Z. Fl.

Lid conical.

2. ***M. asperulum,*** Mitten. Stems slender, creeping; branches short, tufted. Leaves red-brown, dense, spreading, incurved when dry, ligulate from an oblong base, lower obtuse, upper acute, mucronate by the excurrent nerve; margins papillose, rough; perichætial shorter, acute. Fruitstalk $\frac{1}{4}$in. long. Capsule ovoid, attenuate below; peristome 0; mouth darker, plaited, lid conical, acuminate. Calyptra naked, Hook. Handbook, Fl. N.Z. Mt. Wellington.

Leaves canaliculate.

3. ***M. Reinwardtii,*** Schwægr. Leaves open, slightly incurved; when dry curling, from a narrow lanceolate base acuminate, canaliculate; perichætial broadly lanceolate, acuminate; nerve excurrent. Fruitstalk long, capsule ovate, short neck, plicate mouth, 16 narrow teeth. Calyptra glabrous.

Nerve vanishing.

4. ***M. pusillum,*** Mitt. Leaves when dry spirally twisted; when moist open, linear-lanceolate, apex short, apiculate; nerve brownish, vanishing under apex, keeled, entire; perichætial very short, ovate-acuminate. Fruitstalk short, capsule oval, plicate, mouth deep coloured, calyptra naked. Key, No. 7. On stones, Cataract Hill.

Leaves minutely erose.

5. *M. Archeri,* Mitten. Leaves when dry twisted, slightly curling, when moist open elliptic below, from thence lanceolate, slightly obtuse, nerve excurrent, keeled, very shortly apiculate, margin minutely erose; perichætial short, wide, acute. Capsule elongate-oval, deep coloured plicate mouth. Peristome of lid subulate. Calyptra naked. On dead branches of trees, Kermandie Rivulet.

6. *M. Scottiæ,* C. Muell. No description available.

B. Calyptra pilose. Capsule ground.

7. *M. microphyllum,* Hook. et Grev. Stems and branches slender, 1-2in. long. Leaves yellow-brown, when dry, striate and oppressed, ovate or subulate-lanceolate, acute, keeled, two striæ at the base, pellucid, papillose above; nerve stout, vanishing below the tip. Fruit-stalk slender, capsule oval-oblong or sub-pyriform slightly grooved; peristome short, undivided. Calyptra hairy. Key, No. 16. On trees in creeks and damp woods.

Capsule smooth.

8. *M. microstomum,* Hook and Grev. Leaves spreading, sub-incurved, ligulate-lanceolate, obtuse, papillose, apiculate, areolation lax, nerve reddish. Capsule oval, smooth, plicate mouth. Calyptra slightly hairy. Near Hobart, altitude 1,400 feet.

28. ORTHOTRICHUM, Hedwig.

Straight hairs, in allusion to the calyptra being covered with straight hair-like processes. Key, No. 44. On branches and rocks.

1. *O. crispum,* Hedwg. Leaves linear lanceolate, undulated, dilated at base, much twisted and crisped when dry; capsule clavate, long tapering apophysis, striated, contracted below the mouth; calyptra campanulate, very hairy. Wils. Bry. Brit. Key. No. 44. Trunks of trees, St. Patricks River.

2. *O. lutuem,* Mitten. Leaves linear lanceolate, keeled, pale yellow, oblong concave below, nerve yellow, vanishing; margin erose; perichætial longer. Fruit-stalk double length of capsule, capsule cylindric oblong, plicate, teeth eight bigemminate; inner, eight cilia; lid with short beak, calyptra hairy. On trees, rivulet behind Cumming's Head. Mt. Wellington.

3. *O. Tasmanicum*, Hook. *f.* and Wils. Leaves lanceolate subulate, margins reflexed, slightly crisped; fruitstalk rather long; capsule elliptic-oblong, striata when dry. Internal peristome eight rather wide cilie, keeled, entire, connivent. Calyptra pale, shining. On twigs of bushes, Launceston.

4. *O. Lawrencii*, Mitten. Leaves ovate-lanceolate, acute, keeled, upper margin erose; perichætial similar. Capsule oval-cylindric, plicate to the base, on fruitstalk half as long, lid with short beak. Teeth eight, yellow, reflexed when dry, cilia eight similar in size and colour.

29. ZYGODON, Sir W. J. Hooker.

Yoke tooth, in allusion to the paired teeth of the peristome. Key, Nos. 14-24. On trunks of trees and rocks.

A. Leaves entire. Peristome single.

1. *Z. anomalus*, Dozy and Molkb. Stems short, scarcely branched, yellow green, margins undulate, flexuous; when dry, loosely twisted and crisped, oblong lanceolate, keeled, entire; nerve short, excurrent; perichætial shorter, lanceolate-acuminate, erect. Fruitstalk reddish yellow, flexuose. Capsule sub-pyriform, sulcate, mouth contracted, pale brown; lid conic-rostrate. Gully near the Avon, on decayed wood.

2. *Z. intermedius*, Bruch. and Shimp. Stems branched. Leaves lax, erecto-patent, lanceolate-lingulate, subacute. Inner peristome, eight cilia. Key, No. 74. On trees, Mount Wellington.

Peristome double.

3. *Z. Brownii*, Schwægr. The branches reaching an equal height; leaves pale green, spreading, recurved squarrose, oblong, acute; nerve continuous and excurrent. Fruitstalk very slender, $\frac{1}{4}$ to $\frac{1}{2}$in. long. Capsule pyriform, furrowed; peristome double, outer often rudimentary or irregular; in var. 8 cilia. Hook. Handbook N.Z. Fl. Common on rocks, bark of trees, &c., throughout the island.

4. *Z. minutus,* C. Muell. and Hampe. Densely tufty, short, yellowish, tender very short, densely-leafed shoots; stem leaves densely imbricate when moist; when dry strict, oblong lanceolate, acuminate, keeled, entire, convex, nerve strong yellow, excurrent; perichætial narrow. Yellow tender fruitstalk. Capsule erect, oval-pyriform, and striate. Lid conical-oblique, acuminate, external teeth, 16 gemminate, very short, closely joined. Internal, eight cilia in very tender reticulate membrane. Similar to *Codonoblepharun Menziesii*, but distinguished by excurrent nerve and different peristome.

B. Leaves dentate.

5. *Z. cyathicarpus,* Montague. Leaves pale green, spreading, sub-recurved, crisped when dry, linear-lanceolate, acute, keeled, remotely denticulate; perichætial overtopping the capsule. Fruitstalk very sharp; capsule cup form, gymnostomous, striate; lid convex, oblique-beaked. Key, No. 14. Var. Leaves with pellucid nerve. On the ground, Dromedary, New Norfolk.

30. CODONOBLEPHARUM, C. T. Schwrægrichen.

So named in allusion to the inner peristome conniving and forming a campanulate cone. Key, No. 47. On bark of trees.

1. *C. Menziesii*, Schwægr. Stems tufted, densely fastigiately branched, $\frac{1}{4}$in. high. Leaves crowded, suberect, yellow brown when old, lingulate, apiculate, keeled, nerve nearly continuous, strong, reddish, vanishing. Fruitstalk $\frac{1}{10}$in. long, slender. Capsule pyriform, pale, strongly grooved, contracted below the mouth; peristome double, inner 16 cilia conniving and forming a campanulate cone; lid convex, obliquely beaked. *Z. Drummondi*, Taylor; *Z. Menziesii*, Mitten. Fl. Tasm. and Hook. Handbook N.Z. Fl. On the bark of trees, on the ground near the sea.

31. LEPTOSTOMUM, Brown.

Slender mouth. In damp woods in crevices of rocks. Key, No. 21.

1. *L. inclinans,* Brown. Leaves erect, open, loosely imbricate when dry, ovate oblong, obtuse, with a flexuous long hair point toothed at the tip; margin recurved; nerve stout, pale. Fruitstalk slender; capsule inclined obovoid-clavate, lid conico-hemispheric. *Gymnostomum inclinans.* Hook. Musc. Exot. Key, No. 21. On moist rocks, top of Grass Tree Hill.

2. *L. gracile,* Brown. 2-3in. high, closely imbricate when dry, leaves with straight hair point, toothed at the tip; lid hemispherical. Hook. Handbook. Mt. Wellington.

3. *L. Menziesii,* Hook. Tufty. Intermixed with radicles below. Leaves open, elliptic-oblong, apices acuminate, nerve excurrent in long flexuous hair, margin subserrulate, perichætial narrow, subulate, hair rather rough. Fruitstalk rather short, capsule inclined, cylindrical curved; lid conic, oblique, acuminate. Mitten's Sth. Amer. Mosses, p. 274. Mt. Wellington.

4. *L. macrocarpum,* Brown. Leaves elliptic-oblong, slightly obovate, concave, margin revolute, terminated by a branched hair. Capsule erect, ovate-oblong, small mouth. Lid conic-obtuse. *Bryum Macrocarpum.* Mt. Wellington.

32. LEPTOTHECA, Schwægrichen.

Slender capsule, the same as *Aulocomnion* in Hook. Handbook to N.Z. Fl., named in allusion to the plaited capsule. Key No. 50.

1. *L. Gaudichaudii,* Schwægr. Stems erect, slightly branched; leaves lax, erecto-patent, oblong, cuspidate by the excurrent nerve, strongly toothed; capsule erect, narrow, cylindrical. On moist rocks, Mt. Wellington.

33. MNIOPSIS, Mitten.

Acrocarpous. Areolation hexagonal. Outer peristome, 16 teeth; inner, alternating processes from a basilar membrane. Calyptra mitriform, small. Key No. 42.

1. *M. plumula,* Mitt. Stems $\frac{1}{4}$ to $\frac{1}{2}$ in. high, dull green. Leaves inserted horizontally in fertile stems, patent, ovate. Perichætial, ligulate, obtuse. Leaves of sterile stems distichous, vertically inserted, oblong ovate, acute or obtuse; nerve vanishing. Fruit-stalk two lines long. Capsule ovoid-cylindrical, equal. Lid subulate. External teeth long, narrow, red. Below the quarry, Ovens Creek.

34. ORTHODONTIUM, Schwægr.

Straight tooth. In allusion to the filiform straight teeth of the inner peristome. Key, No. 51. On rocky round and on old logs.

1. *O. Australe,* Hook. *f.* and Wils. Stems $\frac{1}{2}$in. long, branched to an equal height. Leaves erecto-patent, slightly recurved, linear, sub-flexuose, nerve sub-continuous. Capsule sub-erect, oblong, short neck. Outer teeth 16, lanceolate-subulate, when dry inflexed to the mouth of the capsule; inner, 16 cilia, filiform. Lid conico-rostellate. Key, No. 54. Kangaroo Bottom, Mt. Wellington.

2. *O. lanceolatum,* Mitt. No description available.

35. LEPTOBRYUM, Br. and Schimp.

Slender moss. Growing in dense silky light green patches on sandstone rocks. Key No. 53.

1. *L. pyriforme,* Br. and Schimp. *Bryum pyriforme,* Hedwig. Stems simple, $\frac{1}{4}$in. long, very slender, rooting only at the base. Lower leaves lanceolate, entire, scattered; upper leaves longer, the terminal ones crowded into a spreading tuft, elongated, linear setaceous, slightly serrated, flexuose, flat, nerved almost or quite to apex. Fruitstalk slender, flexuose, capsule inclined or pendulous, pear-shaped, glossy, golden brown, thin texture, not shrinking when dry, somewhat pellucid, mouth small. Lid convex, mammilate. Wils. Bry. Brit. Key No. 53. On decayed wood, Back River Gully, near River Nile.

2. *L. sericeum,* Hampe. Tufty, fertile stems, very short. Leaves straw colour, erecto-patent, loosely imbricate, ovate from the base, subulate, excurrent piliform nerve; perichætial similar. Fruitstalk 1in. long. Capsule with pyriform neck $1\frac{1}{2}$ lines long, mouth oblique, lid conic-convex, outer teeth lanceolate subulate, inner, a membrane with ciliiform processes. Mitten's Sth. Amer. Mosses, p. 305.

BRACHYMENIUM, Hooker.

Short membrane, in allusion to the inner peristome. Key, No. 42.

1. *B. lanceolatum,* Hook. *f.* and Wils. Stems $\frac{1}{4}$ to $\frac{1}{2}$in. high, tufted, dense young shoots. Leaves, when dry, linear lanceolate, acuminate entire, subflexuose, keeled, nerve continuous, areolation lax, pellucid. Fruitstalk 1in. long. Capsule sub-erect, oval-pyriform, short, plicate; lacerate membrane, divided irregularly into 16 cilia. Lid short, conical, calyptra cucculate.

37. MIELICHHOFERIA, Hornsch.

Named in honour of Mielichhofer. The fructification of this genus is *cladocarpous*, an intermediate state between *acrocarpous* and *pleurocarpous*. Key, No. 39.

1. *M. Eckloni,* Hornsch. Fertile stems very short, nearly basilar. Leaves ovate-lanceolate, acuminate, apex serrulate, nerve vanishing. Long fruitstalk. Capsule cernuous, obovate, pyriform, thence gibbous, outer teeth 16, imperfect; inner, 16 filiform cilia, connected. Key, No. 39. On the ground, Gullies Road, Brown's River.

2. *M. microdonta,* Mitt. Cat. No description available.

38. BRYUM, Linn.

From *βρυον*, a moss. One of the largest genera of mosses, chiefly found in cold and mountainous districts. Key No. 54.

A. Upper leaves rosulute. Nerve sub-excurrent, leaf not waved.

1. *B. truncorum,* Bridel. Stems 1-2in. high, terminal ones rosulate, recurved, crisped when dry, obovate-acuminate, thick margin, recurved below, nerve sub-excurrent. Fruitstalk, curved at the top, capsule narrowed into the fruitstalk, elongate, cylindric, arcuate, drooping; lid short, conical-apiculate. Procter's road, on damp ground.

Nerve excurrent as a long point.

2. *B. campylothecium,* Taylor. Stems 1-2in. high, tomentose. Leaves pale yellowish, imbricate, coriceous, erecto-patent, upper rosulate, but not spreading, obovate-oblong, sub-acute, obscurely serrulate at the apex, not concave; margins thickened, reflexed; nerve excurrent as a long point. Fruitstalk slender; capsule pendulous curved, ovate-oblong or pyriform, with a narrow obconic apophysis; lid conical, mammilate. Hook. Handbook, N.Z. Fl. On the ground, near Proctor's Road.

Leaves crisped and waved when dry.

3. *B. Billardierii,* Schwægr. Stems $\frac{1}{2}$in to 1in. high; upper leaves rosulate, pale green, spreading, crisped, and undulate when dry; ovate-oblong, sub-acute; margin not thickened, reflexed below, apex serrate, nerve sub-excurrent. Fruitstalk stout; neck of capsule curved, suddenly narrowed, drooping, clavate pyriform. Lid sub-conical. Key, No. 54. Wellington Falls.

Nerve reddish.

4. *B. rufescens*, Hook. *f.* and Wils. Closely allied to preceding species, stems more slender. Leaves spathulate, softer, reddish areolation at the base, margin scarcely recurved; nerve reddish. Capsule clavate, arcuate, slightly pendulous, purple mouth. Var. B, *mammilatum*, long excurrent nerve, capsule shorter. Var. γ, *brevifolius*, leaves shorter, concave; capsule shorter. About Hobart, and near Risdon.

B. Upper leaves not larger or spreading. Distinctly serrulate.

Leaves small, oblong-ovate, not crisped.

5. *B. obconicum*, Hornsch. Stems with lateral shoots; leaves oblong-ovate, acuminate, scarcely twisted when dry, serrulate at the apex, slightly keeled. Nerve excurrent, cuspidate; capsule subpendulous, clavate, with a long neck; lid convex, mammilate. Circular Head.

Leaves small, oblong-ovate, crisped when dry.

6. *B. lævigatum*, Hook. *f.* and Wils. Stems ½ to 2in. long, tomentose. Leaves pale yellow green, subserrulate towards apex, very concave, coriaceous, nerve solid. Capsule ovate-oblong, pendulous, lid obtuse conical. On wet rocks.

Leaves lanceolate.

7. *B. nutans*, Schreb. Stems very short, upper leaves long, lanceolate, apices serrate; lower, ovate-lanceolate, entire, capsule drooping or pendulous, oblong-pyriform. Lid large, convex, papillose. Antheridia in pairs in axes of perichætial leaves. Western Mountains, Mt. Wellington.

C. Upper leaves not large and sprrading, entire, or very obscurely serrulate.

Leaves whitish, silvery.

8. *B. argentium*, Linn. Stems very short. Leaves silvery or glaucous, imbricated, broadly ovate, apiculate, concave, quite entire, nerve vanishing below the middle, cells lax. Capsule pendulous, ovoid, red. Lid mammilate. Var. *niveum*; young shoots obtuse, white leaves. Surrey Hills.

Leaves obtuse.

9. *B. blandum*, Hook. *f.* and Wils. Stems tufted flaccid. Upper leaves pale yellow green, shining, lower reddish, loosely imbricate, oblong, obtuse, quite entire, concave. Nerve slender, not quite continuous, reddish, cells lax. Capsule clavate pyriform, cernuous. Var. B. *luridum*.

Leaves ovate-lanceolate, keeled.

10. *B. bimum,* Schreb. Stems matted with purple radicles, ½-3in. high. Leaves yellowish green, spreading, slightly twisted when dry, ovate-lanceolate, keeled, quite entire, nerve excurrent, mucronate. Capsule obovate-pyriform or obconical. Lid large, convex, mammilate. Huon-road.

Leaves lanceolate, keeled, crisped.

11. *B. torquescens,* Br. and Schimp. Stems matted, covered with radicles; leaves much crisped when dry, lower, distant, narrow lanceolate, keeled, margins reflexed, upper crowded, oblong-lanceolate, all concave, quite entire, nerve excurrent. Fruitstalk curved at top; capsule pendulous, subincurved, narrow obconic, with a tapering neck, red-brown, lid broad, mammilate, purple, shining. Wils. Bry. Brit., Mt. Wellington.

Leaves elliptic, lanceolate, not crisped.

12. *B. Tasmanicum,* Hampe. Leaves elliptic-lanceolate, quite entire, nerve excurrent, sub-piliferous, margin recurved. Fruitstalk long; capsule drooping, oval, with neck as long as capsule. Differs from *B. bimum* by longer leaves, more acuminate, and nerve longer excurrent.

Leaves ovate-oblong, nerve scarcely excurrent.

13. *B. crassum,* Hook. *f.* and Wils. Stems elongate, rigid, tomentose. Leaves crowded at the apices of branches; lower, minute, scale-like. Closely imbricate when dry, upper leaves coriaceous, ovate-oblong, acute, concave, margin recurved, almost entire, stout nerve. Capsule pendulous, oblong-pyriform or subcylindric; lid conical, apiculate. Woods on Mt. Wellington.

Leaves ovate-lanceolate; lid yellow, large, mammilate.

14. *B. cæspititium,* Linn. Yellowish or intense green compact tufts; stems 2 lines to 1in. long, with branches and innovations, terminal leaves largest, ovate-acuminate or ovate-lanceolate, nerve excurrent, margin reflexed, not thickened, apex sometimes serrulate. Capsule variable in shape, pendulous, usually oblong-ovate, constricted below the mouth when dry. Lid yellow, large, mammilate. Wils. Bry. Brit. Var. *crinitum*, leaves sub-piliferous, fruitstalk longer, capsule oblong.

Leaves oblong-lanceolate ; lid shortly conical, apiculate.

15. *B. chrysoneuron,* C. Muell. *B. duriusculum,* Hook. *f.* and Wils. Stems short, leaves spreading or erecto-patent, rather rigid, erect when dry, oblong-lanceolate, acuminate, concave, margins quite entire, reflexed; nerve stout, excurrent, or almost so. Fruitstalk very slender, flexuous, capsule cernuous, oblong-pyriform or cylindric, narrow at the base; operculum shortly conical, apiculate. Inflorescence dioicous. Hook. Handbook N.Z. Fl.

Leaves ovate-oblong, piliferous ; lid reddish, apiculate.

16. *B. capillare,* Hedwg. Stems $\frac{1}{4}$ to 1in. long, radiculose below. Leaves more or less spreading, strongly contorted when dry ; lower leaves ovate-oblong, apiculate ; terminal, larger, obovate-oblong, with long slender points, nerve ceasing below the apex or excurrent ; capsule sub-pendulous, oblong-pyriform, clavate or obovate ; lid apiculate. Inner peristome deeply coloured. Wils. Bry. Brit.

Leaf-margin flat ; capsule rounded at base.

17. *B. pacytheca,* C. Muell. Stems short, $\frac{1}{4}$ to $\frac{1}{2}$in. high ; leaves pale dull green, widely ovate-acuminate, concave, margin nearly plain, nerve thick and excurrent. Fruitstalk short, capsule pendulous, ovoid, ventricose, rounded at the base, red-purple, lid short, sub-conical. Var. B. leaves narrow, thicker nerve. Var. *γ. inflatum,* leaves nearly round, concave, incurved. Dry earth, Macquarie Plains, Bellerive.

Fruitstalk very short ; capsule very long, arcuate-clavate.

18. *B. clavatum,* Hook. *f.* and Wils. Leaves erecto-patent, sub-coriaceous, elliptic-lanceolate, concave, thick excurrent nerve. Lid sub-conical. On the ground.

Nerve excurrent, sometimes denticulate.

19. *B. intermedium,* Web. and Mohr. Cæspitose, stems radiculose, branched, sterile branches slender, with loosely-imbricated leaves ; leaves more or less spreading, ovate-acuminate, ovate or oblong, or elongate-lanceolate, nerve excurrent, longish, cuspidate, sub-denticulate, margin recurved. Capsule pendulous, nearly pyriform, sub-clavate, long neck, lid acute, persistent. Turf banks, Glen Leith.

Stem bright red ; leaves elliptic.

20. *B. rubiginosum,* Hook. *f.* and Wils. Stems rigid, elongate. Leaves distant, yellowish-green, membraneous, lax, erecto-patent, apices recurved, elliptic, slightly acute, decurrent, nerve vanishing, areolation pellucid. In wet places (barren specimens only).

39. AULCOMNION, Schwægrichen.

Furrowed moss. In allusion to the furrowed dry capsule. Key, No. 49. At the roots of trees.

1. *A. palustre,* Schwægchr. Stems 2-4in.long, beset almost to the summit with ferruginous radicles. Leaves flexuose, twisted when dry, linear-lanceolate, margin reflexed, apex erose, denticulate. Capsule ovoid or oblong, sub-cylindrical, cernuous, short neck, sulcate when dry ; peristome double ; lid convex, short beak. Var. Stems slender, leaves crisped. Formosa (Barren specimens only, with pseudopodia).

40. BARTRAMIA, Hedwg.

Named in honour of John Bartram, an American botanist. The English name is apple moss, common in Alpine and sub-Alpine localities. Key, No. 45.

A. Bartramidula. Capsule gymnostomous.

1. *B. pusilla (glyphocarpa),* Hook. *f.* and Wils. Stem scarcely two lines in height, the very short stem growing from a creeping stolon. Branches few, subfasciculate, curved, slender. Leaves erecto-patent, very small, ovate, slightly acute, cells lax, sub-entire, with a faint vanishing nerve ; perichætial, short, erect. Capsule reddish-brown, pendulous, and globose; fruitstalk short, arcuate at apex, pale ; lid sub-conical. Brown's River, Mt. Wellington.

B. Philonotis. Capsule with peristome, striate ; with short branches of unequal height (fasciculate), male flowers discoid.

Leaves distant, serrulate, margins flat.

2. *B. remotifolia,* Hook. *f.* and Wils. Stems $\frac{1}{4}$in. short, slender, not thicker than fruitstalk, fasciculately branched ; branches short, slender, recurved ; leaves glacous, distant, spreading, loosely crisped when dry, lanceolate-acuminate, serrulate, margin plane ; narrow pellucid excurrent nerve ; perichætial longer, erect. Fruitstalk stout, long ; capsule sub-erect. *Philonotis appressa,* Mitten. Brown's River, Elliott Rivulet.

Leaves serrulate, inner teeth connected.

3. *B. tenuis,* Tayl. Stems slender, fasciculately branched; branches slender, flexuous; leaves loosely spreading, secund, narrow, lanceolate, serrulate, margins flat, acuminate, with a long spinous point, nerve excurrent; perichætial erect, setaceous point. Fruitstalk long, slender. Capsule inclined; cilia of internal peristome connected at apices; male flowers capitulate, perigonial leaves incurved, long acuminate, serrulate. Deep Gully, Mt. Wellington.

Leaves entire.

4. *B. affinis,* Hook. Stems tomentose, sparingly fasciculately branched; leaves erecto-patent, strict, ovate-lanceolate, acuminate, almost entire, margin recurved, stout nerve, long excurrent. Fruitstalk short. Capsule sub-pendulous, oblong, sub-pyriform, sulcate. Lid conical. Kangaroo Bottom, Mt. Wellington.

Breutelia, leaves sheathing, plicate, squarrose; inflorescence dioicous; male flowers discoid.

Upper cells of leaf short, capsule pendulous.

5. *B. pendula,* Hook. Stems tomentose, branches fascicled; leaves spreading, ovate-lanceolate, long acuminate, serrulate, striate, nerve excurrent. Fruitstalk elongate; capsule pendulous, oblong, sulcate. Mt. Wellington. Alt., 2,000ft.

Nerve sub-excurrent, leaves plicate.

6. *B. crassa,* Hook *f.* and Wils. Stems 1in. high, tomentose, rigid, sparingly and vaguely branched; leaves yellowish, glossy, not crisped when dry, dense, patent, generally secund, amplexicant, ovate at the base, lanceolate-acuminate, plicate, serrulate, nerve narrow, sub-excurrent. Fruitstalk 1½in. long, capsule large, oblong, inclined. Creek above Wellington Falls.

Upper cells of leaf long, capsule pendulous.

7. *B. Sieberi,* Hornsch. Stems 1in. high, procumbent or sub-erect, tomentose, leaves yellowish green, not shining, erecto-patent, lanceolate, nerve narrow, excurrent, setaceous at the point, margin serrulate. recurved below, cells elongate, narrow, papillose, Fruitstalk 1in. high, red; capsule pendulous, ovoid, plicate; lid flat-conical; peristome small, normal.

Leaves divaricating (widely spreading asunder).

8. *B. divaricata,* Mitt. Stems elongate, almost simple, tomentose below; leaves divaricating, the bases sheathing, lanceolate, plicate, papillose, serrulate, nerve excurrent, mucronate, slender. Perichætial ovate, entire, nerve very slender. Flaccid appearance when dry. Fruitstalk long; capsule horizontal, ovoid oblong, neck attenuated, pyriform; lid conical, peristome normal. Cheshunt.

Much fasciculately branched above, capsule inclined.

9. *B. comosa,* Mitt. Stems tomentose below, much fasciculately branched above; leaves divaricating, sheathing base, short, erect, obovate, blade narrow, lanceolate, serrulate, plaited, minutely papillose, nerve excurrent in a slender point; perichætial smaller, ovate-lanceolate. Fruitstalk 1½in. long; capsule ovoid, inclined, grooved; lid conical, peristome normal. Western Mountains, Mount Wellington.

Stems dichotomously branched.

10. *B. elongata,* Mitt. Stems very robust, curved, ascending, 4-6 in. long, ⅙in. in diameter, very sparingly branched. Leaves closely imbricate, sub-erect and sub-secund, pale yellow and shining when dry, ovate-lanceolate, acuminate, plaited, often waved, serrulate, papillose at the back; nerve slender, excurrent. Hook. Handbook, Fl. N.Z.

11. *B. commutata,* Hampe. Description not available.

Bartramia, stems dichotomous, fastigiately branched. Male flowers gemmiform.

Capsule apparently lateral, hidden among the leaves.

12. *B. Halleriana,* Hedwg. Stems elongate, 2 to 6 in. high, vaguely fastigiately branched; leaves yellow-green, spreading or secund, broad and sheathing at the base, linear-subulate, serrulate above; fruitstalk short; capsule sub-globose, immersed; lid conical. Key, No. 45. Mt. Wellington, Western Mountains.

Fruitstalk apparently lateral, ¼in. long.

13. *B. papillata,* Hook *f.* and Wils. Stems 1in. high, sparingly branched; leaves crowded, pale, patent or erecto-patent, subulate, with an obovate sheathing base, minutely serrulate, papillose at the back, nerve solid; capsule sub-erect. *B. acerosa,* Hampe. On rocks, Dry Hill, Back River.

Leaves easily detached, fragile.

14. *B. fragilis,* Mitt. Densely tufty, stems erect, nearly simple. Leaves densely crowded, easily detached, suddenly contracted from an oblong base to long subulate lanceolate, margin and back serrulate, nerve percurrent. Fruitstalk very short; capsule erect, red, globose, furrowed; lid short, conical; peristome, external, normal; internal, very short rudimentary processes. On rocks, rivulet behind Cumming's Head.

41. CONOSTOMUM, O. Swartz.

Cone mouth, in allusion to the peristome. An Arctic and Antarctic genus, on Alpine mountains. Key, No. 28.

Nerve broad.

1. *C. Australe,* Swartz. Stems erect, branched, branches fasciculate; leaves erect, most densely imbricate, linear-lanceolate, acuminate, upper piliferous; nerve broad, excurrent. Capsule nearly globose, inclined. Lid obliquely beaked. Rivulet behind Cumming's Head, Western Mountains.

Nerve narrow.

2. *C. pusillum,* Hook *f.* and Wils. Stout stems. Leaves sub-erect, loosely imbricate, lanceolate-acuminate, sub-piliferous, margin recurved, doubly serrate; capsule inclined, almost cernuous. Key, No. 28. The Falls, and Rivulet behind Cumming's Head.

42. PHYSCOMITRIUM, Bridel.

Bladdery calyptra; so named from the inflated dimidiate calyptra. Key, No. 5. On clay banks.

1. *P. apophysatum,* Tayl. Stems very short. Leaves erecto-patent, ovate-acuminate, sub-serrulate, concave, nerve vanishing. Fruitstalk short; capsule erect, clavate pyriform, when dry constricted below the mouth. The Hummocks.

2. *P. laxum,* Hook *f.* and Wils. In loose tufts. Stem robust, leaves lax; from a narrow base spathulate-ovate-acuminate, entire, nerve vanishing below the middle. Fruitstalk $\frac{1}{2}$in. Capsule ovate. Western Mountains.

3. *P. conicum,* Mitt. Similar to *P. pyriforme,* Br. and Schimp, the leaves of which are sub-spathulate, sub-acute, concave, serrulate, nerve nearly continuous. Fruitstalk 2 lines long; capsule pyriform; lid depressed conical. Less than the usual states of *P. pyriforme,* but very similar. Mitt. Leith's Creek.

43. ENTOSTHODON, Schwægr.

Within tooth, so named from the 16 teeth being inserted below the mouth of the capsule. Key, No. 22. Short, loosely tufted, growing in earth, rarely on stones.

1. *E. gracilis,* Hook. *f.* and Wils. Stems very short; leaves erect, sub-elliptic, acute, sub-carinate, concave, quite entire, nerve vanishing. Fruitstalk elongate, twisted to the left. Capsule erect, pyriform from a narrow apophysis, plicate, exannulate; lid almost plain. Key, No. 22. Brown's River, New Norfolk.

2. *E. productus,* Mitten. Monoicous, small, short; lower leaves ovate, thin, lanceolate, narrow above, quite entire, nerve vanishing below the apex; cells elongate. Fruitstalk two lines long; capsule small, ovoid; lid depressed, convex; peristome 0. On the earth, Western Mountains.

44. FUNARIA, Schreber.

From funis, a cord, in allusion to the twisting of the fruit-stalk. Tufted, growing on earth, burnt wood, soil, &c. Key, No. 48.

Leaves entire, fruitstalk 1in. or more in length.

1. *F. hygrometrica,* Hedwg. Leaves broadly ovate-lanceolate, concave, entire, nerve continuous; perigonial serrate at the apex. Capsule incurved, pyriform, mouth wrinkled. Double ring. Lid convex. Fruit-stalk more or less arcuate. Grass Tree Hill, Brown's River, Bellerive. Appears almost everywhere on burnt ground.

Leaves serrate, fruitstalk $\frac{3}{4}$in. or more in length.

2. *F. Tasmanica,* Hampe and C. Muell. Stems $\frac{1}{4}$ to $\frac{1}{2}$ in. long; leaves spreading, ovate, acuminate, sub-piliferous, serrate, nerve vanishing a little above the middle; fruitstalk arcuate; capsule long clavate-pyriform; peristome perfect. Austr. Mosses, F. v. M. T. I. In Tasmania, accompanied by *Targionia Tasmanica.*

Leaves crisped, fruitstalk ¼in. long.

3. *F. crispula,* Hook. *f.* and Wils. Leaves patent, when dry loosely crisped, obovate, apiculate, concave, subserrulate, nerve vanishing; fruitstalk short, twisted to the left; capsule globose-pyriform, curved, short neck. Lid almost plain. Peristome double, inner yellow. Key, No. 48. Allied to *F. glabra,* Taylr., but differs in the form of the capsule and in the crisped foliage. On rocks, Sth. Huon, Port Sorell.

Leaves not crisped, fruitstalk ¼in. long.

4. *F. glabra,* Tayl. Stems very short. Leaves erecto-patent, obovate, apiculate, serrulate at the apex; nerve vanishing below the apex. Fruitstalk erect, twisted to the left. Capsule clavate-pyriform, curved, gibbous, annulus 0, inner peristome imperfect, lid nearly flat, margin not coloured. Hook. Handbook N.Z. Fl.

45. SPLACHNUM, Br. and Schimp.

The name (σπλαγχνον) is borrowed from Dioscorides, and was originally used for some lichen or cryptogamic plant. Key, No. 23. Growing on old wood, earth, and animal matter.

Leaves serrulate.

1. *S. (Dissodon) callophyllum,* C. Muell. Loosely tufted, tomentose with radicles. Stems very slender, ascending, pale green, flaccid. Leaves loosely imbricate, from a narrow base spathulate-ovate, cuspidate, serrate. Fruitstalk stout; capsule erect, oblong-ovate, small mouth, teeth 8, rising from within the orifice. Lid oblique, obtuse, cuspidate. *Eremodon robustus,* Hook *f.* and Wils. Fern Tree Valley, Mt. Wellington.

Leaves entire.

2. *P. octoblepharum,* Hook. Leaves obovate, long acuminate, sub-piliferous, quite entire; capsule clavate; teeth 8, in pairs; calyptra naked. *Dissodon plagiopus,* C. Muell. Key, No. 23. Var. γ. *majus;* leaves wider. Common on cowdung.

Capsule with oblate apophysis.

3. *S. Gunnii,* Hook and Wils, Stems rigid, thick, short, tomentose. Leaves tinged with red. squarrose, obovate or spathulate, acute, concave, dentate, nerve vanishing. Fruitstalk short, thick, red. Capsule conical, with a large oblate apophysis, pale, of firm texture, scarcely altered when dry. Teeth 8, incurved slightly when dry. Calyptra minute, conical, base inflexed, naked. On dead fern trees, Acheron River.

46. BUXBAUMIA, Albert von Haller.

Named in honour of J C. Buxbaum, a German botanist. Key, No. 55. Growing on soil or decayed wood.

1. *B. Tasmanica,* Mitt. Similar to *B. indusiata,* leaves very small, ciliate. Fruitstalk shining, sub-scabrous. Capsule sub-erect, ovate; upper surface plain, immarginate; lower surface convex. Lid conical. Peristome apparently composed of smooth bladdery cells, scarcely free from the internal membrane. Cheshunt.

47. POLYTRICHUM, Linn.

Many hairs, alluding to the hairy calyptra. Dark green or brown plants, growing on the earth or at the roots of trees. Key, No. 49.

Atrichum, calyptra narrow, cucculate, elongate, naked, apex very spinulose. Capsule cylindrical. Lid with slender beak. Leaves lanceolate-ligulate, nerve narrow, sparingly lamillate, sub-flaccid.

1. *P. angustatum,* Hook. Stem slender; leaves elongate, lanceolate, crisped when dry, spinulose-serrate above. Capsule cylindrical, sub-erect; lid with slender beak, calyptra naked. *Atrichum angustatum,* Bryol. Eur., *A. ligulatum,* Mitt. Var. *polysetum,* fruitstalks aggregated. Mt. Wellington, Southport Narrows.

Psilopilum, peristome teeth 16-32, very short. Capsule ovate, ventricose. Calyptra hairy at the tip, naked below.

Leaves entire.

2. *P. Australe,* Hook. *f.* and Wils. Stems short; leaves crowded, erect and incurved when dry, ovate-subulate, densely lamellate, quite entire. Fruitstalk short; capsule inclined, ovate ventricose, small mouth; lid beaked. Calyptra short, scabrid at the tip. Around Hobart, on stones and on the earth.

Leaves denticulate.

3. *P. crispulum,* Hook. *f.* and Wils. Leaves rather flaccid and spreading, crisped when dry, oblong-lanceolate, sub-acute, toothed, incurved, lanceolate. Fruitstalk elongate; capsule inclined, ovoid, small mouth. Lid rostrate. Teeth 32, minute, narrow. Western Mountains.

Cyphoma. Capsule flat above, gibbous below. Calyptra sub-nude. Teeth 32-64. Leaves acutely serrate, rigid, base sheathing.

4. *P. Magellanicum,* Hedwg. Stems branched. Leaves spreading and recurved, rigid, base ovate, sheathing, thence subulate, serrate. Capsule inclined or horizontal, oblong, semiterete. Lid conico-rostrate, calyptra slightly hairy. *Polytrichadelphus Magellanicum,* Mitt. *Catharinea (Polytrichadelphus) innovans,* C. Muell. Mt. Wellington.

POGONATUM. Calyptra hairy, capsule terete. Lid with long beak.

5. *P. alpinum,* LINN. Leaves spreading and recurved, long linear lanceolate, sheathing at the base, margin incurved, sharply serrate, spinulose at the back, lamellar. Capsule erect or inclined, ovoid or oblong, furnished with a short swollen neck. Lid with a long beak. Calyptra with red-brown hairs, teeth short, sub-irregular. Western Mountains.

6. *P. tortile,* SWARTZ. Stems simple, 1-2in. high, leaves loosely spreading, incurved when dry, sheathing at the base, thence linear-lanceolate, flat, serrate. Fruitstalk 1in. high. Capsule sub-erect, nearly terete, obscurely six-lined; lid convex, with a short beak. Calyptra clothed with matted hairs. *P. subulatum,* Menz. Hook. Handbook N.Z. Fl. Mt. Wellington.

7. *P. Gullivери,* HAMPE. No description available.

POLYTRICHUM, capsule angular, furnished with discoid apophysis. Lid shortly beaked. Calyptra hairy. Teeth 64. Columella alate.

Leaves serrate.

8. *P. commune,* LINN. Long stems. Leaves sheathing at the base, spreading, recurved, long linear-lanceolate, serrate, lamellate; perichætial, sheathing, membraneous, erect. Capsule 4-angled. Lid with short beak. Var. B. Stems short, slender. Bogs, Brown's River. Bogs near Huon.

Leaves entire.

9. *P. juniperinum,* HEDWG. Leaves spreading, recurved, sheathing at the base, linear-lanceolate, aristate, margin inflexed, quite entire. Capsule 4-angled, horizontal; lid beaked. Summit of Mt. Wellington.

48. DAWSONIA, BROWN.

Named in honour of Dawson Turner. Large, handsome mosses, rigid, dark green. Key, No. 41. In forests and on roots of trees.

1. *D. superba,* GREV. Stems very long. Leaves with ovate sheathing base, linear, very long, rigid, spinulose-serrate. Fruitstalk short, thick. Capsule partially hidden by the leaves; peristome of numerous cilia, like a brush; calyptra small, covered with hairs. Emu Bay.

49. LEUCODON, BRIDEL.

The name of the genus (λευκος, white, οδούς, tooth) is not strictly applicable, the peristome usually being pale yellow. Key, No. 61. On rocks and trees.

1. *L. Lagurus,* Hook. Stem and branches covered with matted fibrils. Leaves bright green, glossy, imbricate, oblong-ovate, concave, acuminate, piliferous, not striate, scarcely nerved. Capsule erect, sub-cylindrical, lid obliquely rostrate. *Stereodon Lagurus,* Mitten. Near the top of Mt. Wellington, south side.

50. CLADOMNION, Hook *f.* and Wils.

Lateral branching moss, loosely tufted, creeping, with erect, long, slender branches. Key, No. 71.

Capsule sulcate, leaf nerveless.

1. *C. sciuroides, Leskea,* Hook. Stems creeping; branches sub-erect; incurved, rather flattened; leaves erecto-patent, sub-secund, ovate, acuminate, plicate, striate, serrate at the apex, nerve 0. Fruitstalk short. Capsule erect, oblong, sulcate. Double peristome, inner a deeply divided membrane, 16 carinate processes. Lid conical-subulate. *Stereodon (Achyrophyllum) sciuroides.* On twigs and trunks of trees in dense woods.

Capsule smooth, leaf nerved.

2. *C. setosum (Anœctangium),* Hedwg. The young upright shoots elongate, nearly simple. Leaves crowded, sub-secund from an ovate base, thence subulate-setaceous, serrate, nerve solid. Fruitstalk very short. Capsule erect, smooth, oblong. Lid beaked. *Neckera setosa,* Hook. *Spiredeus,* Mitt. *Pilotrichum,* C. Muell. *Cyrtopus setosus,* Hook. Handbook N.Z. Fl.

51. LESKEA, Hedwg.

Named in memory of Leske, a professor at Leipsic. Key, No. 65.

L. imbricata, Hook. *f.* and Wils. Monoicous. Stem creeping; young erect shoots vaguely or sparingly branched, branches curved, thickened above. Leaves imbricate, crowded, rotundo-ovate, margin almost plain, strong nerve vanishing under the apex. Moist rocks on Mt. Wellington. Foliage brownish or lurid. This is, perhaps, a young state of *Cryphæa.* Mitt. in Fl. Tasm.

52. METEORIUM, Bridel.

That which is suspended in the air, in allusion to the habit of this genus in creeping over trees and stones, pendulons, very long. Key, No. 72.

Leaves oblong-spathulate, obtuse.

1. *M. molle (Leskea)*, Hedwg. Shoots very long, pendulous, flexuose, flaccid, branches nearly simple. Leaves imbricate, sub-spathulate, elliptic, oblong, obtuse, concave, quite entire, nerve 0. Perichætial sheathing, double the length of stem leaves. Fruitstalk short. Capsule ovoid. Lid beaked. Calyptra hairy, dimidiate. *Stereodon molle*, Mitt. Var. *B. majus*, branches tumid, fruitstalk longer, capsule unequal. Brown's River.

Leaves cordate ovate, apiculate.

2. *M. cuspidiferum (Neckera)*, Tayl. Shoots very long, pendulous, flexuose, flaccid; leaves loosely imbricate, erecto-patent, cordate-ovate, semi-amplexicant, apiculate, auricle at base slightly denticulate, elsewhere quite entire, keeled, substriate, nerve vanishing, areolation very minute. *Trachypus Hornschuchii*, Mitt. On trees.

Leaves cordate-ovate, crispato-undulate.

3. *M. cerinum,* Hook. *f.* and Wils. Very long, pendulous; leaves, when dry, crisp-undulate, cordate-ovate, acuminate, quite entire, nerve vanishing, auricles nearly entire. *Trachypus cerinum*, Mitt. On trees, in creeks. More robust than *M. cuspidiferum*, leaves yellowish, auricles larger, reflexed when dry.

Filiform. Auricles entire.

4. *M. filipendulum,* Hook. *f.* and Wils. Stems long, slender, pendulous, branches spreading, flexuose, simple, very attenuated. Leaves ovate-acuminate, quite entire. On trees.

Very slender. Auricles toothed.

5. *M. flexicaule (Leskea)*, Tayl. Long, pendulous, flexuous. Leaves loosely imbricate, cordate-ovate or sub-spathulate, acuminate, concave, not striated, quite entire except at the obscurely toothed base. Nerve to the middle. On trees.

53. CRYPHÆA, Mohr.

Hidden, in allusion to the concealed capsules. Key, No. 77. Creeping on trees or rocks.

1. *C. consimilis,* Mont. Stems branched, distant, spreading, filiform. Leaves ovate-lanceolate, acuminate, quite entire, margin slightly recurved, nerve nearly continuous, capsule oblong, immersed in piliferous perichætial leaves. Lid conical, acute. On dead timber, Coal River Tier.

2. *C. parvula,* Mitt. *C. consimilis*, not of Mont. Stems creeping. 1-2in. long. Branches and stem leaves as in the preceding species, perichætial broadly obovate, retuse, suddenly produced into a piliferous acuminate point. Fruitstalk scarcely visible. Capsule ovoid; lid conical, acute. Calyptra, red-brown, rough at the apex. Hook. Handbook N.Z. Fl.

3. *C. Tasmanica,* Mitt. Stems frequently naked below, crowded above with many close-set branches. Leaves spreading, orbicular-ovate, acute, margin flat, most minutely serrulate, nerve vanishing below the apex, perichætial subulate from an ovate base, overtopping the capsule. Lid convex, acute, ring double. On rocks, Jackey's Plain Creek.

54. NECKERA, Hedwg.

Named in commemoration of Necker, a celebrated botanist. On trunks of trees. Key, No. 62.

1. *N. pennata,* Hedwg. Stems pinnate, leaves ovate-lanceolate, acuminate, serrulate, undulate, nerve inconspicuous. Perichætial, long-lanceolate, acuminate. Capsule immersed, lid shortly beaked, calyptra small, scarcely covering the lid. *N. hymenodonta*, C. Muell. On trees, rivulets, and damp copses, near Launceston.

55. OMALIA, Bridel.

Flat, in allusion to the complanate leaves. Key, No. 64. On trunks of trees and on shady rocks.

1. *O. falcifolia,* Hook. *f.* and Wils. Stems sub-pinnately branched, branches complanate, almost simple ; leaves distichously imbricated, oblong, broad, flat, falcate, obtuse, nerve 0. quite entire. Fruitstalk smooth. Capsule elliptic-oblong, drooping ; lid conical.

56. TRACHYLOMA, Bridel.

Rough-edged, in allusion to the nodose teeth of the peristome. Tree-like, flattened, pinnately branched. Key, No. 63.

1. *T. planifolium,* Bridel. *Neckera planifolia,* Hook. Stems erect, pinnately branched, branches complanate; leaves distichously imbricating, erecto-patent, ovate, serrate at the tip, inconspicuous nerve; capsule erect, sub-cylindric, lid conical subulate. Growing 3in. high on dead trees, in forest, Esk River.

57. ISOTHECIUM, Bridel.

Equal capsule. Tree-like in form. On rocks and trees. Key, No. 73.

A. Stems sub-erect, sub-pinnately branched, 1in. high, nerve 0.

1. *I. gracile,* Hook. *f.* and Wils. Stems branched, branches recurved. Leaves erecto-patent, elliptic, concave, hardly acute, secund, obscurely toothed, nerve 0; perichætial squarrose, acuminate. Fruitstalk smooth, capsule oblong, cernuous; lid conical. On stones in rivulets.

1in. high, leaf nerved half-way.

2. *I. pumilum,* Hook. *f.* and Wils. Stems dendroid, pinnately branched, scaly below, branches complanate. Leaves ovate or ovate-oblong, serrulate, nerve slender, reaching half way to apex; perichætial, sub-squarrose, ovate-ligulate. Fruitstalk short, smooth. Capsule ovoid, cernuous, ringed. Lid beaked. *Neckera rivalis,* Mitt. West End Rivulet and Stackhouse Falls.

Stem 2-3in. long, capsule sub-erect.

3. *I. arbuscula* (*Hookeria,* Smith). Stems bi-pinnately branched; leaves imbricate, spreading, ovate, concave, quite entire, nerves 2, indistinct. Fruitstalk short, flexuose; capsule sub-erect or cernuous; lid conical. Var. *B. deflexum,* stem arcuate, and rooting at the apex. Leaves more acute and less concave. On trees in dense forests.

4. *I. angustatum,* Mitt. Very similar to *I. arbuscula,* but smaller in all its parts, 2-3 pinnately divided; leaves spreading, sub-compressed, narrow oblong-ovate, acute, concave, quite entire, those in the branches serrulate above; perichætial, subulate, spreading. Capsule short, ovoid, horizontal. Hook. Handbook N.Z. Fl. Mt. Wellington.

Capsule pendulous.

5. *I. (Porotrichum) fruticosum,* Mitten. Similar to *I. arbuscula,* but the more acute ovate leaves and the drooping capsule on elongated fruitstalk, sufficiently distinguish it. Mitten's Cat. Austr. Mosses.

B. Hypnodendron. Stems dendroidal, rigid

Leaves ovate, acute, serrated.

6. *I. spininervium* (*Hypnum*, Hook. Musc. Exot.) Branches simple, spreading. Leaves sub-distichously imbricate, ovate, acute, margin and back serrated, nerve solid. Capsule oblong, cernuous, sulcate. Lid rostrate, shorter than the capsule. *Trachyloma arcuata*, Mitt. On the ground and on stones in bed of rivulets.

Leaves ovate-lanceolate, dotted, serrated.

7. *I. Archeri*, Mitten. Branches so disposed as to form a sub-triangular frond. Leaves ovate-lanceolate, acute, nerve percurrent, margin serrate. Cells minutely papillose, punctate; perichætial, ovate, thin, slender, acuminate; capsule horizontal, oblong, sulcate; lid with long curved beak. Teeth normal. On the banks of creeks in forests.

Branches whorled.

8. *I. comosum*, Labill. In dense tufts, stem tomentose with matted radicles, branches in crowded whorls, sub-erect, leaves rigid, spreading, sub-secund, ovate-lanceolate, with a rigid subulate apex; margin serrate, nerve thick, terete. Fruitstalks numerous, capsule oblong, pendulous, sulcate; lid with long beak. Key, No. 73. Mt. Wellington.

Branches fascicled, lateral, decurved. Nerve keeled.

9. *I. Sieberi* (*Hypnum*, C. Muell). In loose tufts. Stems robust, tomentose, branched laterally, not whorled, stout, deflexed, sub-cuspidate. Leaves crowded, erecto-patent, narrow lanceolate, gradually acuminate, striate when dry, margin thickened, coarsely serrate, nerve stout, keeled at the back, excurrent. Numerous fruitstalks. Capsule horizontal, sulcate. Lid with long beak. Mt. Wellington.

Branches fascicled, lateral, decurved. Nerve terete, spinulose.

10. *I. Colensoi*, Hook. *f.* and Wils. In loose tufts, with habit and ramification of *I. Sieberi;* leaves lax, patent, sub-secund, rigid, cordate, lanceolate at the base, narrowed into a long acuminate setaceous apex; nerve excurrent, stout, punctulate at the back, serrate and spinulose at the point. Capsule pendulous, elongate, cylindrical, 8-grooved, curved; lid with long beak. *Isothecium comatum*, C. Muell.

58. HYPNUM, Linn.

From ὕπνος, Sleep. One of the largest genera of mosses, found in all parts of the globe.

In the following groups the arrangement in Fl. Tasm. and Hook. Handbook N.Z. Fl. is followed as closely as possible :—

Key to Groups.

I. Stems and branches covered with matted radicles amongst the leaves.

A. Tamariscina. Leaves small, nerve strong. Fruitstalk smooth.

II. Stems and branches not covered with radicles.

a. Leaves imbricate all round the stem, squarrose, or erect, or incurved, or secund, or falcate, not 2-farious or distichous.

Leaves more or less falcate and secund, often circinnate.

B. Adunca. Stem flacid. Lid short, conic.

C. Hispida. Stems elongate, rigid. Nerve very strong. Lid beaked.

D. Cuppressiformia. Stem flaccid. Nerve 0. Lid beaked.

Leaves spreading, not squarrose, nor large, nor concave.

E. Prælonga. Fruitstalk scabrid. Lid beaked.

F. Conferta. Fruitstalk smooth. Lid beaked.

G. Rutabula. Fruitstalk scabrid. Lid conic.

Leaves squarrose and spreading, large and often concave.

H. Stellata. Capsule not grooved.

I. Ptychomnion. Capsule grooved.

Leaves closely imbricate, not squarrose, large and concave,

J. Cochlearifolia.

b. Stems compressed. Leaves imbricate. The lateral spreading 2-farioms,

K. Distichophylla.

Distinctive Characters of Groups of Hypnum.

A. Tamarascina. Stems pinnately or bipinnately branched, covered with matted green fibrillous rootlets. Leaves imbricated all round the stems and branches, not two farious or distichous, nerve stout.

B. Adunca. Leaves falcate, secund ; nerve single, continuous or vanishing below the apex. Fruitstalk smooth. Lid short, conical. Often aquatic or marsh mosses.

C.—Hispida. Stems rigid, stiff, sparingly branched. Leaves falcate and secund, nerve very stout.

D. Cupressiformia. Stems flattened. Leaves more or less secund, falcate or circinnate, imbricate all round the stem or obscurely 2-farious ; cells at the outer base often large. Nerve 0. Fruitstalk smooth (rather rough in *H. cerviculatum.*

E. Prælonga. Leaves spreading, imbricate all round the stem, not squarrose nor secund, serrulate, nerved halfway. Fruitstalk scabrid, lid beaked.

F. Conferta. Leaves imbricating all round the stem, not squarrose nor secund, usually small and serrulate. Fruitstalk smooth, lid beaked.

G. Rutabula. Leaves spreading, imbricate all round the stem, not squarrose, rarely sub-secund. Fruitstalk rough ; lid short, conical.

H. Stellata. Leaves imbricated all round the stem, small, spreading, and squarrose. Fruitstalk smooth, capsule not grooved.

I. Acicularia. Stems stout, sub-erect, sparingly branched. Leaves imbricated all round, squarrose, large, very concave, flaccid, serrate, nerveless. Capsule grooved or angled. Calyptra large, inflated.

J. Cochlearifolia. Stems stout or slender, prostrate, sometimes pendulous. Leaves imbricated all round, often appressed, not squarrose or secund, very concave and inflated, transparent, obtuse or apiculate ; nerve 0 or obscure. Fruitstalk smooth. Capsule not grooved.

K. Distichophylla. Stems and branches compressed. Leaves inserted all round the stem, but distichous, nerveless or obscurely nerved.

A. TAMARISCINA.

Stems closely bi-pinnate.

1. *H. furfurosum,* HOOK *f.* AND WILS. Stems elongate, procumbent, scaly, rigid, closely bi-pinnate; branches slender, attenuate; stem leaves squarrose, cordate-acuminate, concave, keeled, plaited, nerve vanishing; those of the branches sub-erect, incurved when dry, ovate-acuminate, apex denticulate, papillate at the back, nerve vanishing; perichætial, narrow, acuminate, denticulate. Fruitstalk smooth; capsule oblong, cernuous; lid beaked. *Leskea hastata* (Hypnum). C. Muell. Near Hobart, on the ground.

Stems distantly bi-pinnate.

2. *H. unguiculatum,* HOOK *f.* AND WILS. Allied to the preceding species, but more slender in habit. Stems about 2in. long, distantly branched. Stem leaves small, not concealing the stem, spreading, cordate-acuminate, distant, sub-plicate, sub-entire; branch leaves distant, much bent inward when dry, but not appressed, ovate-acute, concave, smooth at the back; nerve slender, pellucid, vanishing; perichætial, piliform, acuminate, denticulate, Fruitstalk 1in. long, smooth, capsule oblong, arcuate; lid beaked. Teeth yellow, longer than in *H. furfurosum*; inner peristome reddish, with cilia. Near Hobart, on the ground.

Stems scarcely pinnate.

3. *H. Stuartii,* O. MUELL. Very similar to *H. hastata,* but the stems irregularly branched, scarcely pinnate; the larger branches stoloniferous. Perichætial, sheathing, plicate, margin revolute, including very many long paraphyses, nerve excurrent. Capsule pendulous, turgid (swollen), oblong. Teeth, inner, golden, separate, with very short cilia interposited.

Frond of linear outline.

4. *H. fulvastrum,* MITT. Similar to *H. furfurosum,* but branches short and close set, giving a linear outline to the frond. Cauline leaves secund, plaited, those of the branches and branchlets evenly disposed on every side; perichætial, much ciliate. Hook. Handbook. N.Z. Fl. On the ground, Bellerive.

Leaf with long flexuous, slender point, scarcely serrulate.

5. *H. læviusculum,* MITT. Very similar to H. *tamariscinum.* Leaves of the stem with flexuous points, nerve thick, excurrent; perichætial erect, pale, ovate-lanceolate. much attenuated, flexuous, sub-serrulate. *Leskea læviuscula,* Mitt. Mt. Wellington.

B. ADUNCA.

6. *H. fluitans,* LINN. Monoicous. Stem sub-pinnately branched, thin, flaccid. Stem leaves remote. Branch leaves falcate-secund, lanceolate, acuminate, nerve vanishing. Fruitstalk long, capsule oblong, arcuate, cernuous, lid sub-conical. In wet places, Yorktown.

C. HISPIDA.

7. *H. hispidum,* HOOK. *f.* AND WILS. Stems long, arcuate, vaguely or sub-pinnately branched; leaves imbricate, rigid, secund, ovate below, somewhat plaited, long subulate, setaceous, quite entire, nerve stout, excurrent. Fruitstalk rather short, smooth. Capsule ovoid, cernuous. Lid with a curved beak. *Leskea hispida,* Mitt, *H. aristatum,* Sullivant. Stones, in running water, Back River Creek.

D. CUPRESSIFORMIA.

I. Lid as long as the capsule.

* Leaves strongly falcate or circinnate.

H. cerviculatum 8
H. tenuirostre 9
H. amœnum 10

** Leaves slightly falcate.

a. Leaves quite entire or obscurely serrulate.

H. contiguum 11
H. Joliffii 12
H. homomallum 13

b. Leaves distinctly serrulate.

H. leptorynchum 14
H. cyparioides 15

II. Lid shorter than the capsule.

Leaves strongly falcate, ovate-lanceolate, nerveless.

H. chrysogaster 16
H. cupressiforme 17
H. limatum 18

8. *H. cerviculatum,* HOOK. *f.* AND WILS. Stems creeping, sub-pinnately branched. Leaves falcate-secund, lanceolate-acuminate, apex attenuated, serrated, margin scarcely reflexed, nerve 0. Perichætial erect, ovate-lanceolate, apiculate, serrate. Fruitstalk short, stout, roughish. Capsule oblong, horizontal, strumose base, no ring. Lid with long beak. *H. leptorynchum.* Var. B. Fl. Antarct. *Stereodon cerviculatus,* Mitt. On trees around Hobart.

9. *H. tenuirostre,* Hook. Stems creeping, sub-pinnately branched; branches elongate, erect; leaves crowded, falcate, secund, ovate-lanceolate, acuminate, concave, almost entire, nerve 0. Capsule ovoid-oblong, cernuous. Lid with long beak. *Hypnum Terræ Novæ.* Var. B. Fl. Antarct. Mt. Wellington.

10. *H. amœnum,* Hedwg. Stems prostrate, vaguely and pinnately branched, 1-2in. long; branches short, their apices incurved. Leaves yellow-brown, shining, falcate and secund, lanceolate, long acuminate, concave; quite entire; cells large, pellucid at the marginal base, nerves 0; perichætial broader, entire or serrulate towards the apex. Fruitstalk $\frac{1}{2}$ to $\frac{3}{4}$in. long, very slender, red. Capsule horizontal, ovoid, urceolate when dry; lid with a slender beak as long as the capsule. Hook. Handbook Fl. N.Z. Mt. Wellington, Bellerive.

11. *H. contiguum,* Hook. *f.* and Wils. Stems subpinnately branched, apices of the branches subcuspidate. Leaves loosely imbricate, sub-secund, not falcate, lanceolate, acuminate, piliferous, quite entire, slightly concave, cells at the marginal base inflated, perichætial longer, erect. Fruitstalk short, smooth. Capsule ovoid-oblong, pendulous; lid with long beak. Trunks of trees, Mt. Wellington.

12. *H. Joliffii,* Mitt. Branches with cuspidate apices; leaves loosely imbricate, oblong-acuminate, concave, obscurely 2-nerved or nerve 0, quite entire or subserrulate at the apex, cells at the marginal base larger and hyaline; perichætial similar, erecto-patent. Fruitstalk slender, capsule small, ovoid, horizontal or inclined; lid with beak as long as the capsule; peristome, inner, solid ciliary processes 2-5 exserted from a membrane, ring simple. On stones and earth, Western Creek, Cheshunt.

13. *H. homomallum,* C. Muell. Leaves purplish or golden brown, glossy, erecto-patent secund, broadly ovate-acuminate, cochleariform-concave, quite entire, nerve 0, margin recurved, marginal cells at the base, square; perichætial straight, narrow. Fruitstalk short, smooth. Capsule oblong, sub-cernuous, curved. Lid with long beak. *Leskea homomalla,* Hampe. *H. Drummondii,* Tayl. On rocks, not uncommon. On rocks facing the sea at Eaglehawk Neck.

14. *H. leptorynchum,* Bridel. Stems creeping, sub-pinnately branched; leaves falcate, secund, linear-lanceolate, acuminate, serrulate at the apex, margin sub-recurved, nerve 0, twisted when dry. Fruitstalk slender, smooth; capsule oblong, drooping; lid with long beak. *Stereodon cyparioides*, Mitt. Near Hobart, on trees.

15. *H. cyparioides,* Bridel. Very similar to the preceding species; leaves sub-distichous, shorter; perichætial narrower, gradually acuminate; fruitstalk shorter, more slender, arcuate at the apex; capsule minute, ovoid, pendulous, constricted under the mouth. Southport, with the preceding.

16. *H. patale,* Hook *f.* and Wils. *Steredon chrysogaster (Hypnum)*, C. Muell. *H chrysogater*, Hook. Handbook. *H. cupressiforme*, Fl. Antarct. Stems procumbent, pectinately (divided or branched like a comb) branched, branches crowded, spreading, flattened above. Leaves falcate, secund, ovate-lanceolate, acuminate, distichously spreading, apex sub-serrulate, nerve 0, pale green, glossy, yellowish at the base. Perichætial, erect, acuminate, setaceous, serrate. Fruitstalk long. Capsule horizontal, ovoid-oblong. Lid conical, apiculate. On trees, slopes of Mt. Wellington.

17. H. *cupressiforme,* Linn. Stems vaguely and pinnately branched; branches incurved. Leaves falcate-secund, ovate-lanceolate, concave, nerve 0, cells at the marginal base opaque, square. Capsule sub-cylindric, subcernuous. Lid conical, cuspidate. Var. B. *minus*, branches slender, leaves narrower. Moist rocks, Mt. Wellington.

18. *H. limatum,* Hook *f.* and Wils. Dioicous. Stems sub-pinnately branched, branches simple, incurved. Leaves secund or falcate, ovate-lanceolate, sub-piliferous, sub-entire, nerve 0. Perichætial, long, recurved, sub-piliferous, sub-serrulate. Capsule cylindrical, sub-erect, lid short, conical, apiculate. *Hypnum Terræ Novæ.* Var. B. *Australi*, Hook. Fl. Antarct. Var. Leaves less, falcate-secund, scarcely-piliferous, perichætial narrower, fruitstalk longer, capsule arcuate. Damp Gullies, Brown's River.

E. PRÆLONGA.

19. *H. muriculatum,* HOOK. *f.* AND WILS. Monoicous. Stems small, sub-pinnately branched. Branches short, simple, sub-compressed. Leaves spreading, cordate, ovate, acuminate, sub-serrulate, apices sub-piliferous, attenuate, nerved beyond the middle. Fruitstalk rough. Capsule oblong, horizontal. Lid, long beak. Circular Head, Hobart.

20. *H. austrinum,* HOOK. *f.* AND WILS. Monoicous. Stems creeping, vaguely branched. Branches sub-erect, almost simple, incurved. Leaves spreading, sub-secund, ovate-cordate, acute, concave, serrulate, nerved beyond the middle. Perichætial erect, attenuate. Fruitstalk rough. Capsule ovoid, cernuous. Lid beaked. Wet places, Back River Gully.

21. *H. asperipes,* MITT. Monoicous. Stems procumbent, branches pinnate. Leaves spreading, ovate, acuminate, serrulate, nerve slender, vanishing near the middle. Fruitstalk rough, 1in. high. Capsule oval-oblong, horizontal. Lid with long beak. Cheshunt.

F. CONFERTA.

22. *H. collatum,* HOOK. *f.* AND WILS. *H. confertum,* Fl. N.Z. *H. tenuifolium,* Hedwg. Monoicous. Stems procumbent, pinnately branched. Branches robust, compressed. Leaves spreading, broadly ovate, acuminate, concave, serrulate, nerve slender, vanishing near the middle, areolation very narrow, linear. Perichætial, long acuminate, recurved. Fruitstalk smooth. Capsule cernuous, oblong, curved. Lid with long beak. Var. β, *laxifolium.* Stems longer, branches longer, leaves distant, fruitstalk longer. Var. γ *minus,* stems erect, slender, sparingly branched, branches erect, nerve slender, scarcely compressed, leaves erecto-patent. Var. δ, capsule inclined, symmetrical. On decayed wood in damp, shady places. Var. β, Back River Gully. Var. γ, at the foot of trees. Coal River Tier.

23. *H. aristatum,* HOOK. *f.* AND WILS. Monoicous. Stems pinnately branched; branches slender, attenuate. Leaves spreading, sub-compressed, lax and flexuous when dry, oblong-acuminate, piliferous at the apex, concave, serrulate, margin not reflexed; perichætial, erect, acuminate. Fruitstalk smooth. Capsule cernuous, arcuate, oblong. Lid with short beak. Growing with *H. collatum,* Cheshunt.

G. RUTABULA.

24. *H. rutabulum,* LINN. Monoicous. Stems vaguely branched. Leaves loosely imbricate, spreading, ovate-acuminate, serrulate, nerved beyond the middle, striate when dry. Fruitstalk rough. Capsule ovoid, cernuous, lid conical. Var. 2. Flowers synoicous. Swamps on Mt. Wellington.

25 *H campestre,* (*Brachythecium*, BR.) Monoicous, long, loosely tufty. Long stem prostrate or ascending, much branched; branches ascending, flexuous, sub-pinnate. Leaves crowded, erecto-patent, long, ovate-lanceolate, short or long subulate-acuminate, striate, margin serrate, shining; perichætial, long, subulate, subulate part recurved. Fruitstalk rough. Capsule ovoid, oblong cylindrical, cernuous, curved. Lid conical. Longford.

26. *H. paradoxum,* HOOK *f.* AND WILS. Stems creeping, sub-pinnate. Leaves falcate and secund, ovate, lanceolate, acuminate, striate, serrulate, nerve interrupted. Fruitstalk rough; capsule ovate-oblong, cernuous. Cheshunt.

H. STELLATA.

27. *H. decussatum,* HOOK. *f.* AND WILS. Dioicous. Stems procumbent, pinnately branched; branches simple; leaves spreading, squarrose, recurved, ovate, long acuminate, almost entire, nerve nearly continuous, reddish or tawny. Fruit unknown. Bog, New Norfolk.

28. *H. oblongifolium,* HAMPE. No description available.

I. ACICULARIA, PTYCHOMNION.

29. *H. aciculare,* LABILL. Dioicous. Stems vaguely branched; branches stout, long, simple. Leaves spreading and squarrose, ovate, long acuminate, apex serrate, nerve 0. Capsule sub-cylindric, curved, furrowed. Lid with long beak. Very common, on the earth, in woods.

J. COCHLEARIFOLIA.

30. *H. cochlearifolium,* SCHWÆGR. Dioicous. Stems long, vaguely branched. Branches stout, erect, simple. Leaves spreading, imbricate, sub-rotund, obtuse, concave, almost hemispherical, quite entire, nerve 0. Perichætial sheathing. Capsule ovoid, sub-cernuous; lid conical. *Hypnum flexile*, Hook. Musc. Exot. *Isothecium flexile*, Bridel. Key, No. 74. Common in woods.

31. *H. clandestinum,* Hook. *f.* and Wils. Monoicous. Male flowers amongst the leaves of the fertile stem. Stem creeping, vaguely branched straight or incurved. Leaves spreading, imbricate, broadly oblong, very obtuse, inflate-concave, like a boat, scarcely nerved. Perichætial sub-squarrose; capsule ovoid, cernuous; lid conical. On moist trunks of trees, Mt. Wellington.

32. *H divulsum,* Hook. *f.* and Wils. Dioicous. Stem long, filiform, vaguely branched; branches rigid, suberect, curved or straight. Leaves spreading, loosely imbricate, rounded obovate, concave, obtuse or subacute, minutely serrulate, nerve reaching half way, areolation punctiform; perichætial squarrose. Capsule ovoid, cernuous. Lid conical, acuminate. Shady places; gully, foot of Grass Tree Hill.

33. *H. chlamydophyllum,* Hook. *f.* and Wils. Monoicous. Stems prostrate, vaguely branched. Branches long, erect, simple, cuspidate. Leaves spreading, imbricate, orbicular-sub-quadrate, auricled, sub-pellucid at the base, concave, quite entire, nerve vanishing, very short. Fruitstalk long; capsule ovoid-oblong, cernuous; lid conical. *H. auriculatum,* Mont. On moist banks. Mt. Wellington.

34. *H. vagum,* Hornsch. Stems ascending, stout, much vaguely branched. Leaves broadly ovate, shortly acuminate, almost nerveless; perichætial long, sheathing, more or less reflexed. Fruitstalk elongate, erect, smooth, flexuous. Capsule oblong, nearly horizontal, purple; lid conical, subulate, straight. Hook. Handbook N.Z. Fl.

K. Distichophylla.

35. *H. extenuatum,* Bridel. Dioicous. Stems procumbent. 3in. long or more. Irregularly and bipinnately branched, with short erect branches, often fasciculate, with numerous flagelliform branchlets; leaves yellowish, somewhat glossy, spreading, ovate-lanceolate, acuminate, piliferous, nerve 0; those of the upper branches appressed, narrower, muticous; perichæetial erect, quite entire, apices capillary. Fruitstalk long, smooth. Capsule ovoid, inclined. Leaves less piliferous than *H. crinitum.* Mt. Wellington.

36. *H. crinitum,* Hook. *f.* and Wils. Dioicous. Stems long, procumbent, irregularly and pinnately branched. Branches distant, flattened, acute. Leaves erecto-patent, sub-compressed, concave, ovate-oblong, obtuse, long piliferous, sub-serrulate, nerve 0. Fruitstalk long, smooth. Capsule ovoid, cernuous; lid conical. On trunks of live trees, near Springs, Mt. Wellington.

37. *H. politum,* Hook. *f.* and Wils. Dioicous, vaguely branched. Branches long, procumbent, compressed. Leaves bright green, shining, imbricate, distichous, compressed, oblong, keeled, sub-piliferous, quite entire, nerve 0. Fruitstalk long, smooth. Capsule oblong, horizontal; lid conical, beaked. *Phyllogonium callichroum*, Mont. Key, No. 69. Damp places, Mt. Wellington.

38. *H. denticulatum,* Linn. Monoicous. Stems prostrate, sparingly branched. Leaves complanate, obliquely-ovate, sub-acute, quite entire, margin recurved below, nerves 2, short, basal. Capsule sub-cylindric, inclined. Lid conical, acute. English name: Sharp flat-leaved feather moss.

59. RHIZOGONIUM, Bridel.

Angle rooted, so named from the manner in which the stems rise erect from the creeping rhizome. Key, No. 66 and 75.

A. Leaves distichous.

Nerve vanishing.

1. *R. distichum,* Bridel. Dioicous. Leaves distichous, ovate-oblong, apices dentate, nerve stout, vanishing below the apex; capsule oblong, horizontal; lid conical, rostellate. *R. Muelleri*, Hampe. *Hypnum distichum* Schwægr. Mt. Wellington, Leith's Creek.

Nerve excurrent.

2. *R. Novæ-Hollandiæ,* Bridel. Dioicous. Leaves yellowish-green, distichous, slightly thickened at the margin, oblong-ovate, denticulate, nerve excurrent; capsule oblong, horizontal; lid beaked, nearly as long as the capsule. *Leskea Novæ-Hollandiæ*, Schwægr. Var., leaves secund. On rotten trunks of trees near Springs, Mt. Wellington.

Doubly serrate.

3. ***R. bifarium,*** SCHIMPER. Dioicous. Stems branched above; leaves distant, distichous, spreading, ovate-lanceolate, slightly thickened at the margin; nerve solid, doubly spinulose-serrate; capsule ovoid, horizontal; lid conico-acuminate, sub-rostellate. *Hypnum bifarium*, Hook. *Isothecium bifarium*, Bridel. Bearing fruit midway, not at the base. Branches few, slender, curved to one side. Rachis zig-zag. Leaves dull green. Setæ ½in. long; capsule small, roundish.

4. ***R. aristatum,*** MITT. CAT. No description available.

B. Leaves not distichous.

Leaves pellucid.

5. ***R. pellucidum*** (*R. reticulatum*, Mitt. Sth. A.M.), HOOK. *f.* AND WILS. Branches 1in. high; leaves compressed, green, pellucid, unchanged when dry, laterally spreading, elongate-lanceolate, slenderly acuminate, nerve percurrent, apices serrulate, cells elliptic-oblong, lax, pellucid, perichætial narrow.

Leaves linear-subulate.

6. ***R. spiniforme,*** HEDWG. Monoicous. Leaves loosely imbricate, spreading, rigid, linear-subulate, margin thickened, nerve excurrent, doubly serrate. Fruitstalk elongate from the base; capsule oblong, horizontal, curved; lid rostrate. *Hypnum spiniforme*, Linn. Mt. Wellington.

Leaves linear-lanceolate.

7. ***R. sub-basilare,*** SCHIMPER. Monoicous. Branches erect. Leaves erecto-patent, sub-secund, not compressed, lax, linear-lanceolate, pellucid, nerve vanishing, spinulose serrate, rarely double serrate; fruitstalk long, sub-basilar; capsule sub-cylindric, horizontal, lid conical. *Hypnum sub-basilare*, Hook. M.E. *H. mnioides*, Schwægr. Mt. Wellington.

Leaves twisted when dry.

8. ***R. mnioides*** (*Hypnum*, BRIDEL.) Dioicous. Leaves erecto-patent, lanceolate-subulate, decurrent at the base, twisted when dry, margin narrowly thickened, doubly dentate, nerve solid; fruitstalk long from the base; capsule ovoid, sub-cernuous; lid rostrate. *Hypnum mnioides*, Hook. M.E. *H. sub-basilare*, Schwægr. Var. β. *contortum*, stem more slender, leaves shorter, twisted when dry, margin involute, perichætial long, linear, acuminate. Mt. Wellington. Var. γ. *lutescens*, stems lower, leaves lanceolate, crisped, areolation larger. Western Mountains.

60. HYMENODON, Hook *f.* and Wils.

Membranaceous tooth, alluding to the narrow basal membrane uniting the teeth of the peristome. Key, No. 57. On trunks of trees and on the ground.

1. *H. pilifer,* Hook *f.* and Wils. Dioicous. Leaves laxly and distichously imbricate, spreading, elliptic-oblong, flat, long piliferous, crenulate, nerve vanishing; perichætial lanceolate-acuminate, erect. Fruitstalk long and slender, basilar. Capsule inclined, oval, contracted at the mouth; peristome simple, teeth 16, membranaceous, equi-distant, linear-subulate, fugacious, tips cohering. Lid beaked. Calyptra dimidiate. Habit as *Rhizogonium.* On trunks of tree ferns, banks of Huon River.

61. HYPOPTERYGIUM, Bridel.

The name refers to the fruitstalk being produced under the leaves. Key, Nos. 60, 67, and 80.

1. *H. Smithianum,* Hook. *f.* and Wils. Dioicous. Stems bipinnately branched, naked below. Leaves distichous, orbicular-ovate, apiculate, rather concave, margin decurved, nerve vanishing, apex denticulate; dorsal orbicular, acuminate, with a stout nerve; capsule pendulous; lid rostrate. *H. Novæ Zealandiæ,* C. Muell. *Hookeria rotulata,* Smith. The leaves are arranged in a deltoid form. Mt. Wellington. Var. Leaves crisped when dry, dorsal oblong, fruitstalk more slender, more arcuate.

2. *H. glaucum,* Sullivant. A very small species; stems tufted, $\frac{1}{4}$in. high; branches forming a nearly orbicular crown, pale glaucous yellow-green, decurved. Leaves closely imbricate, very deflexed, broadly ovate-acuminate or apiculate, obscurely serrulate; nerve produced half-way or more; dorsal large, compared with others, orbicular, acuminate, with the nerve continuous. Fruitstalk stout, arcuate. Capsule ovoid, cernuous; lid with a slender beak, nearly as long as the capsule. Hook Handbook N.Z. Fl.

62. LOPIDIUM, Bridel.

A scale, referring to the rough fruitstalk. Key No. 68. In damp forests.

1. *L. pallens,* Hook. *f.* and Wils. Monoicous. Stems erect, bipinnately branched, naked below; leaves bifarious, ovate-oblong, shortly acuminate, margin thickened, toothed at the apex, twisted when dry; dorsal cordate, acuminate; perichætial shorter. Fruitstalk slender, long, rough. Capsule horizontal, ringed. Lid rostrate. Teeth thickly trabeculated. *Leskea concinna,* Schwægr. *Hypopterygium Struthiopteris,* Bridel. On trunks of tree ferns, Huon River. Distinguished from *L. concinna*, Hook. M. E., by the inflorescence and by the rough fruitstalk.

63. CATHAROMNION, Bridel.

Neat moss. The leaves are pale green and hoary from the long cilia. Fruitstalk $\frac{1}{4}$in. long. Key No. 59. In damp forests, on the ground.

1. *C. ciliatum,* Hook. *f.* and Wils. Dioicous. Stems pinnately branched, naked below. Leaves bifarious, orbicular-ovate, with long cilia, nerve vanishing; dorsal much smaller, ovate-lanceolate, acuminate, ciliate, mixed with setæ. Fruitstalk very short, stout. Capsule oblong, nearly erect. Lid beaked. Calyptra conico-mitriform, base torn. *Pterigynandrum ciliatum,* Hedwg. *Hypopterygium ciliatum,* Bridel.

64. CYATHOPHORUM, Bridel.

Bearing a cup, alluding to the exsertion of the short fruitstalk from a minute cup on the stem. Key No. 78. On fallen tree ferns, in gullies, Mt. Wellington.

1. *C. pennatum,* Bridel. Dioicous. Stems erect, very flat. Leaves distichous, ovate-oblong, oblique, serrate; nerve short; dorsal orbicular, apiculate. Fruitstalk very short, curved. Capsule ovoid. Lid conico-acuminate. *Hookeria pennata,* Hook. M. E. Var. *β. minus,* leaves distant, acute. In gullies, Mount Wellington.

65. RACOPILUM, Palisot.

Rachis hairy, alluding to the stem being more or less tomentose, with brown radicles. Key Nos. 76-79. Creeping on wood, rock, on the ground.

Leaves acuminate.

1. *R. Australe,* Hook. *f.* and Wils. Dioicous. Stems creeping, tomentose with radicles, sub-pinnately branched. Leaves crisped when dry, lateral distichous, spreading, oblong-ovate ; long pellucid excurrent nerve, apex serrulate. Fruitstalk stout. Capsule oblong, decurved, strumose, cernuous, sulcate. Lid shortly beaked. Calyptra hairy, inflated at the base. *R. strumiferum,* C. Muell. Johnny's Creek, Cheshunt.

Leaves obtuse.

2. *R. cristatum,* Hook. *f.* and Wils. Monoicous. Stems creeping. Leaves lateral distichous, spreading, crisped when dry, ovate-oblong, obtuse, serrulate at the apex, nerve excurrent in a point; dorsal much smaller, ovate-cordate, acuminate. Fruitstalk slender ; capsule curved, grooved. Lid with short beak. Calyptra dimidiate, subulate, scarcely pilose. Teeth scabrid at the back. *R. tomentosum,* C. Muell. Huon River, on the ground; Kangaroo Bottom ; St. Patrick's River.

66. HOOKERIA, Sir J. E. Smith, founder of the Linnæan Society, London.

Named in honour of Sir William Jackson Hooker. Key No. 81. On fallen trees and banks by streams.

A. Sauloma, Hook *f.* and Wils. Leaves sub-secund, not margined ; cells large, lax. Outer teeth remotely barred at the back ; inner keeled, without interposed cilia. Calyptra naked, inflexed at the base, not fimbriate.

1. *H. tenella,* Hook. *f.* and Wils. Dioicous. Stems short, sparingly branched. Leaves crowded, imbricate, sub-erect, secund, ovate-oblong, acute, margin re-curved, nerve 0, cells lax, pellucid, when dry plicato-striate. Capsule sub-cernuous, small, ovoid. Lid beaked. Calyptra naked, mitriform. Near Springs, Mt. Wellington.

B. Mniadelphus, C. Muell. Calyptra conico-mitriform, base fimbriated. Inner peristome without cilia. Leaves margined or not, nerved or not.

* Leaves with thickened margins.

Leaves serrulate.

2. *H. apiculata,* Hook. *f.* and Wils. Dioicous. Leaves orbicular, apiculate, margin thickened, cells large, nerve 0. Fruitstalk rough, capsule cernuous, calyptra hairy, fimbriate at the base. Circular Head.

Leaves entire, cells small.

3. *H. crispula,* Hook *f.* and Wils. Dioicous. Branches flattened. Leaves lax and distichous, spreading, when dry crisped and undulate, obovate, apiculate, margin thickened, quite entire, nerved half way, areolation small, nearly round; perichætial ovate-acuminate. Fruitstalk slender. Capsule horizontal, narrow-oblong, pale; lid with a slender straight beak, nearly as long as the capsule. Calyptra fimbriate at the base. Leith's Creek, Cheshunt.

Capsule apophysate.

4. *H. pulchella,* Hook. *f.* and Wils. Dioicous. Branches soft, flattened. Leaves crowded, distichous, imbricate, undulate, obovate, obtuse, mucronulate, margin thickened, quite entire, nerved half way; perichætial obtuse; capsule inclined, apophysate. Lid beaked; calyptra fimbriate, apex glabrous. Rivulet near Cuming's Head, Western Mountains.

Leaves not apiculate, margin reflexed.

5. *H. amblyophylla,* Hook. *f.* and Wils. Dioicous. Branches stout, compressed. Leaves crowded, distichous, erecto-patent, appressed when dry, obovate, very obtuse, margin thickened, quite entire, nerve vanishing, margin recurved, perichætial obtuse, calyptra fimbriate. Springs, Mt. Wellington.

Leaves yellowish, crisped when dry.

6. *H. sinuosa,* Hook. *f.* and Wils. Dioicous. Branches compressed. Leaves obovate, obtuse, margins thickened, nerve vanishing, entire, when dry undulate, crisped. Closely allied to the preceding species, leaves yellowish of firmer texture, areolæ smaller, except at the base, near the nerve, where they are larger, lax, and pellucid. Perichætial small, obtuse. Fruitstal lin., smooth, glossy, red, strong. Calyptra densely fringed, apex roughish. Arthur's Lakes.

** Leaves without thickened margins.

7. *H. microcarpa* (*Hypnum,* Hedwg.) Dioicous. Stems vaguely branched, branches compressed. Leaves distichous, imbricate, obovate, obtuse, margin not thickened, quite entire, areolation lax and pellucid from the base to the middle; perichætial minute, ovate-lanceolate. Capsule small, cernuous or erect, ovoid. Lid rostellate; calyptra fimbriate at the base. Grass Tree Hill, in wet places.

C. Pterigophyllum, Bridel. Calyptra not fimbriate at the base, more or less laciniate. External teeth remotely barred. Leaves flattened, not margined, obtuse, areolation lax. Nerve forked, vanishing.

Leaves blackish, capsule oblong,

8. *H. denticulata,* Hook. *f.* and Wils. Stems sub-erect, sparingly branched, 1in. high. Branches compressed, sub-incurved, rigid when dry. Leaves shining, pale green when fresh, opaque black, crisped and fragile when dry, loosely sub-4-fariously imbricate, lateral distichous, oblong, ovate or obovate, obtuse or sub-acute, margin toothed, not thickened; dorsal orbicular; nerve short, vanishing, 2-fid, cells large, hexagonal; perichætial small, ovate. Fruitstalk $\frac{1}{2}$in. long, stout, red. Capsule cernuous or pendulous, oblong, narrowed at the base; lid short, beaked. Calyptra glabrous, coriaceous, not fimbriate at the base. Inflorescence dioicous. Hook Handbook N.Z. Fl.

Leaves brownish, capsule sub-pyriform.

9. *H. nigella,* Hook. *f.* and Wils. Dioicous. Stems short, erect, incurved, sparingly branched. Leaves lurid, shrinking when dry, rather remote, flattened, spathulate, obovate, dentate, nerved to the middle; perichætial rotundo-ovate, concave, forming a bulb; capsule sub-pyriform, pendulous; rostrate lid nearly as long, calyptra sub-conical, naked. Teeth with two rather rigid, red, dorsal ridges.

10. *H. obscurum,* Mitten. Plants 2-3in. in width, sparingly branched; leaves 3 lines long, distichous, compressed; lateral spreading, wide elliptic-spathulate, narrowed towards the base; intermedial spreading, sub-trapezoidal, obtuse; nerved to the middle, nerve bifurcate, upper margins crenulate-serrate. Cells of the upper part $\frac{1}{300}$in. in diameter. Whole plant obscure, blackish-green. Cheshunt.

67. DALTONIA, Hooker and Taylor.

Named in honour of the Rev. James Dalton, a cryptogamic botanist. Key No. 82. On moist, shady rocks, and on the stems and branches of trees in mountainous districts.

1. *D. pusilla,* Hook. *f.* and Wils. Monoicous. Stem short, decumbent, nearly simple. Leaves spreading, more or less secund, loosely crisp when dry, narrow lanceolate, acuminate, quite entire, margined, nerve vanishing. Fruitstalk short, slender, slightly rough at apex. Capsule inclined, oblong, base attenuate. Teeth and cilia very long, very narrow, papillate. Stem 2 lines long. Seta 2 lines long. Peristome half as long as the capsule, or more, widely spreading and recurved when wet. Teeth reddish-brown, distantly trabeculate. Calyptra fringed at the base. Near Springs, Mt. Wellington.

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NATURAL GEOMETRY.

By Alfred Mault, Engineering Inspector to the Central Board of Health.

At a time when the desirability and importance of imparting technical education to all classes are generally admitted, an effort to render such education easier to both teacher and pupil is worth consideration. Intelligent reasoning is the basis of all such education. And of such reasoning mathematical is the most important, and perhaps the most difficult, to the young and uneducated.

There are two ordinary methods of learning mathematics: one, the Euclidian, which follows a road to a goal that the traveller does not see until he arrives at it; and the other, the method of most books on arithmetic and mensuration, which shows the goal without pointing out the road that leads to it. The Euclidian mode is wearisome to the young pupil, as he cannot see the use of proving in the abstract certain mathematical truths, even if his reasoning powers are sufficiently trained to do more than learn the propositions by rote. The idea that this is all that his reasoning powers are capable of doing has led the authors of arithmetical manuals to content themselves with giving him dry rules without troubling to prove to him the correctness of these rules. I propose to bring under your consideration to-night a third method, in which the pupil can see the end of the reasoning from the beginning, and can recognise the utility and necessity of each step that has to be taken to logically arrive at that end. I do not wish to decry the Euclidian method, but to explain and vindicate it to untrained minds—to show by a train of concrete reasoning, visible and tangible, that geometry is not a mere course of dry abstract induction, but a logical series of steps, each one of which it is necessary to climb in order to reach stages of truth yet in advance.

There is no novelty in applying concrete reasoning to the solution of mathematical propositions. It is not only allowable, but necessary. Euclid himself used it perforce, though as little as possible. But seeing that he was driven to use it so early as in the fourth proposition of the first book of his Elements, it may be said that all his work is partly founded upon concrete reasoning. Many distinguished mathematicians have advocated

the more extensive use of this palpable reasoning wherever it was practicable,—notably the late Dean Cowie, formerly Mathematical Professor at Woolwich. And it is a remarkable fact that we owe one of the most striking and beautiful concrete demonstrations—that of determining the volume of the pyramid—to a blind man, Sir Isaac Newton's friend, Dr. Sanderson, who can only have arrived at this concrete demonstration by abstract reasoning.

The method I am about to bring under your notice was chiefly elaborated by my friend Monsieur Edouard Lagout, a distinguished engineer in the service of the French Government, and has been very extensively adopted in the technical schools connected with the War Department and the Ministries of Agriculture and Public Works, as well as in the primary and normal schools. To explain it I have had certain models prepared. And I must ask you to excuse my beginning by showing you some very simple self-evident demonstrations, as in describing the system it is necessary to begin with its elements—with the simplest problems.

You will see that the models would themselves explain most of the definitions necessary to be understood, so I need not occupy time therewith. And furthermore, we will to-night, if you please, take for granted the usual axioms.

PLANE GEOMETRY.

If we take twelve separate square inches as shown by these models and arrange them together in three rows as in Figure 1, it is evident that they form a rectangular oblong or parallelogram with an area of twelve square inches, for we can count the square inches that exactly cover the parallelogram.

Again, if we arrange nine of them in three rows, as in Figure 2, it is evident that they form a rectangle of an area of nine square inches, for we can count the square inches that exactly cover it.

It is equally evident that we can tell the area of any other rectangle we make by arranging any number of these square inches by counting them. But if we made the rectangle of a great number it would take a long time to count them, so that we should find it easier to count the number of rows there are in the rectangle and the number of square inches in each row and to multiply the two numbers together; for we find that this will give the same number as the counting of all the square inches will. Thus, in the first figure there are three rows with four in each row, and three times four are twelve, the same number as we counted; and in the second figure there are three rows with three in each row, and three times three are nine, which is also the same number as we counted. In like manner,

however, we arrange a rectangle we shall find that this multiplication will give us the area.

We can now go a step further. We see that each square inch is an inch long and an inch high, that is, each side of it is an inch long. So it is evident that when we put four of them in a row the bottom line of the row is four lineal inches long, and that when we put three rows in height the side line is three inches high. And as this *lineal* measure of length and height represents the rectangle of Figure 1, whose area was twelve square inches, we find out these two things:—First, that as four *lineal* inches multiplied by three *lineal* inches give this area of twelve *square* inches, *square* measure is the product of the simple multiplication of two *lineal* measures; and secondly, that we need not count the rows of square inches in a rectangle, nor the number of them in each row, but by simply measuring with a rule the length and height of it, and multiplying these together, we shall get the area of the rectangle. Thus we have proved the correctness of the rule that multiplying the length by the height will give the area of a rectangle.

We have also illustrated some other things. For example: if the rectangle be a square like Figure 2, it is evident that in multiplying the length by the height we were multiplying a number by itself—three by three. As this produces a square, multiplying a number by itself is called squaring it, and the product of a number multiplied by itself is called its square. Thus, nine is the square of three, twenty-five of five, and so on. Again, as a square of an area of nine inches is based upon a line of three inches, and is, as it were, grown upon it, three is called the square root of nine, and in like manner five is the square root of twenty-five, and so on.

To revert to the rule for obtaining the area of a rectangle. We proved its truth by applying square inches, which for the present we have assumed as our standard measure, actually to the rectangle. But as all our standards for measuring areas are squares—square inches, square feet, square miles, and so on—it is evident that we cannot in like manner prove the correctness of a rule for measuring areas that are not rectangular. For instance, we cannot cover Figure 3 with square inches; either some parts of the figure will be uncovered, or some parts of the square inches unoccupied. How, then, can we be sure that we are right when we say that such an irregular figure contains so many square inches?

Let us take a rectangle like Figure 4, and call it rectangle A. If it is eight inches long and four inches high, we know that its area is $8 \times 4 = 32$ square inches. Then let us divide it into a square and two triangles by these models arranged as in Figure 5; it is evident that the base of the square is four

inches, for its height is four inches, and therefore that its area is $4 \times 4 = 16$ square inches. It is also evident that the base and height of each of the triangles is four inches. The square and the two triangles together cover the whole of the rectangle A, and therefore the sum of their areas is equal to the area of the rectangle. Now let us take another rectangle, B, equal to A, and the same two triangles, and arrange them therein as represented in Figure 6 with this sloping parallelogram between them ; the sloping parallelogram and the two triangles together cover the whole of the rectangle exactly, just as the square and the triangles did. If we now from the equal rectangles take the equal triangles, the remainders must be equal, that is, the sloping parallelogram is equal to the square. Wherefore the area of the sloping parallelogram is 16 square inches. But the base and vertical height of the sloping parallelogram are each four inches, as the base is the difference between the base of the rectangle and that of one of the triangles, $8 - 4 = 4$; and the vertical height of it is the height of the rectangle. And as multiplying this base by this height, four by four, make 16, it is evident that the area of this sloping parallelogram is to be found by the multiplication of its base by its height.

It is evident that whatever shaped parallelogram we may take, we can form a rectangle by applying two equal right-angled triangles to it as shown in the upper part of Figure 7. If we then arrange the two triangles as shown in the lower part of Figure 7, it is evident that we leave a smaller rectangle, that must have a base, height, and area each respectively equal to those of the sloping parallelogram in the upper part of the figure, and that these equal areas are the product of the multiplication of the equal bases and heights. Consequently we can extend the rule we have proved, and say of any parallelogram, whether rectangular or not, that its area is equal to its base multiplied by its height ; and have shown that we can apply square measure to the measurement of things that are not square. But it is to be noted how square measure asserts itself by demanding that the base and height shall be measured at right angles, or, popularly speaking, *squarely* to each other.

We can extend the principle we have thus established. If two equal triangles, such as the models we have been using, be placed together, so that one side of one coincides with the equal side of the other, and the other equal sides are opposite to each other, it is evident that they form a parallelogram, for the opposite sides are equal. Thus these equal right-angled triangles may be arranged to form either the parallelogram shown in Figure 5, or that shown in Figure 8. And these equal scalene triangles may be arranged to form the parallelo-

grams shown in Figures 9, 10, or 11. Every triangle may thus be regarded as half of a possible parallelogram. In every parallelogram thus formed of two triangles, it is evident that each triangle has the same base and vertical height as the parallelogram, and half its area; and equally evident that, if multiplying its base by its whole height will give the area of the whole parallelogram, multiplying its base by half its height will give half its area, that is, the area of the triangle. Wherefore the area of a triangle is equal to its base multiplied by half its height.

As triangles can be thus measured, all plane surfaces bounded by straight lines can be measured, for they can all be divided into triangles. Thus a field of the shape of Figure 12 can be divided as shown, and then the area of each triangle being found, the sum of these areas will be the area of the field.

The power we thus possess of measuring triangles, is the aim and goal of all geometry. The angles and the areas of other figures cannot be ascertained by measuring their sides. Four or any greater number of lines of any given lengths may describe figures of infinitely varied shapes and areas. Thus these four lines, each of four inches in length, may describe a square of 16 square inches in area, as shown in Figure 13, or a parallelogram of any smaller area, one of which is shown by Figure 14. But these three lines, each four inches long, can only describe the one shape and area shown in Figure 15. To alter its shape or area, the length of one or all of its sides must be altered, consequently the lengths of the sides of a triangle fix its shape—that is, determine its angles also; but the lengths of the sides of a polygon do not. So the dividing of a polygon into triangles ties the figure into a fixed shape, and therefore, in surveying, the diagonal lines that do so are often called *tie* lines.

By these concrete, visible demonstrations, we have now proved the truth of rules that enable us to measure any accessible plane bounded by straight lines. But very often there are parts of planes that are so inaccessible that we cannot apply our measures to them. How, then, are we to measure them, and how are we to be sure that our measurements are exact?

I cannot occupy your time, nor pretend within the limits of this paper to give the complete course of Geometry that is involved in the answer to this question. But to show how much this course can be facilitated by concrete methods, let me visibly demonstrate the 47th proposition of the 1st Book of Euclid's Elements without having to previously demonstrate all the preceding propositions that lead up to it.

Let us take two equal squares A, and B, Figure 16, and four equal right-angled trangles F, G, H, and I, and arrange them as shown so as to leave a square C inscribed in A. The square C and the four triangles occupy the whole of square A. Now let us take the same four equal right-angled triangles and arrange them in the two parallelograms upon square B, leaving two squares D and E. The two squares D and E and the four triangles occupy the whole of square B. If from the equal squares A and B we take the equal right-angled triangles the remainders are equal, therefore the square C must be equal to the sum of squares D and E.

But the square C is the square of the hypotenuse of each of the equal right-angled triangles F, G, H, and I, and the square D is the square of one of the sides containing the right angle, and E is the square of the other side containing the right angle. Wherefore the square of the hypotenuse of these right-angled triangles is equal to the sum of the squares of the sides containing the right angle. And as it is evident that the same result would follow whatever shaped right-angled triangles we took to arrange as we have shown—and in practice I would make students use other shaped ones—it follows that in all right-angled triangles the square of the hypotenuse is equal to the sum of the square of the other sides.

The truth thus demonstrated is the basis of all trigonometry, and by it we can not only exactly measure the inaccessible, but we can also sufficiently exactly measure the incommensurable. It is beyond the scope of this paper to show how this is done. But to illustrate how concrete demonstrations may be used to simplify the proofs of measurement of the incommensurable, let us take the rule for ascertaining the area of a circle by multiplying half the circumference by the radius.

If the circle (Figure 17) be divided into 24 equal parts, as in this model, half these parts may be arranged with their points one way and half with their points the other (one of these parts being again divided into two). The circle has now assumed a rectangular shape (Figure 18), the length of which is half of the circumference, and the height of which is the radius. The bases of the triangles are not perfectly straight lines, but had the circle been divided into hundreds or thousands of triangles instead of twenty-four, the eye could not have detected the little curves. And as the calculated length of the circumference is taken in the rule it may be held to be exact.

SOLID GEOMETRY.

However useful concrete demonstrations may be in Plane Geometry they are greatly more so in Solid Geometry, as it is always difficult to explain—to beginners at least—the

figure of a solid projected upon paper. This is especially the case when solids of one form have to be divided into solids of other forms for purposes of measurement or of demonstration.

You will readily see, without my occupying time by actual demonstration, how, by forming rectangular parallelepipeds with these cubic inches, we can prove that multiplying their length by their breadth will give their base, and multiplying this base by their height will give their volume, in a manner analogous to that employed with square inches to form and measure rectangles:—how we can thus illustrate that cubic measures are the result of the double multiplication of lineal measures, just as square measures are the result of their single multiplication:—how we can show the meaning of the terms *cube* and *cube root* as we did that of *square* and *square root*:—how we can extend the rule for measuring rectangular parallelepipeds to all parallelepipeds, by dividing rectangular ones into two equal prisms as in these models (Figure 19), and then arranging the prisms as in Figure 20, to form a sloping parallelepiped, wherein it is evident that the base, height, and volume of the solid are unchanged however much its shape may be:—and how, by this division of parallelepipeds into prisms we may prove that the volume of the prism is equal to one of its rectangular sides as base multiplied by half its height.

As all planes bounded by straight lines may be divided into triangles, so all solids bounded by such planes may be divided into pyramids. Therefore if we can measure pyramids we can measure all such solids. That the formula for measuring pyramids—volume = base $\times$ $\frac{1}{3}$ height, is correct may be proved by concrete demonstrations of various kinds, as, for instance, this one based on the beautiful one imagined by blind Dr. Sanderson, that is before alluded to.

Let us take the two cubes represented by these models (Figures 21 and 22) and say they are each three inches in length, breadth, and height. They are consequently equal to each other, each having a volume of 27 cubic inches, and their basis are equal to each other, being each $3'' \times 3'' = 9$ square inches. If one be now divided into six equal pyramids (Figure 21), and the other into six equal layers (each a parallelepiped) as in Figure 22, it is evident that each pyramid is equal to each layer, for each is respectively the sixth part of equal cubes, that is, each has a volume equal to $\frac{27}{6} = 4\frac{1}{2}$ cubic inches. This is evidently the volume of each layer, for the height of each is $\frac{3}{6} = \frac{1}{2}$ an inch, and the base $9'' \times \frac{1}{2} = 4\frac{1}{2}$. But as the base of the pyramid is also $9''$ it must also be multiplied by $\frac{1}{2}''$ to produce its volume of $4\frac{1}{2}$ inches. As the height of two pyramids is equal to that of the cube, this height

is $\frac{3}{2} = 1\frac{1}{2}''$ and $\frac{1}{2}''$ is one third of this. Wherefore the volume of one of these pyramids is equal to its base $\times$ $\frac{\text{height}}{3}$.

Again, by dividing a cube into three irregularly-shaped pyramids (Figure 23), as shown by these models, each pyramid has the same base and height as the cube, but only a third of its volume. As multiplying the base by the height gives the volume of the cube, so multiplying its base by a third of its height must give a third of its volume, that is, the volume of one of the equal pyramids.

I will not further occupy your time by ocular demonstration that the formula holds good whatever the form of the pyramid, but will conclude with a practical exhibition of the utility of the system.

When materials of any description, such as corn, or gravel, or broken stone are formed into regular heaps for measurement, they are usually put into a shape more or less like a truncated pyramid. Suppose that these models (Figure 24) be a heap of sand to be measured, and that the heap is 12 feet *long* at the bottom and 8 feet at the top; 8 feet *broad* at the bottom and 4 feet at the top; and 3 feet *high* measured perpendicularly: what is the volume of it?

One or other of two methods is usually employed to find this out. The first is to multiply the mean length by the mean breadth, and the product by the height. From the dimensions we have assumed, the mean length is 10 feet and the mean breadth 6 feet, and the height 3 feet. Therefore, $10 \times 6 \times 3 = 180$ cubic feet for the volume of the heap.

The other method is—Multiply the mean base by the height. From the above dimensions the lower base is $12 \times 8 = 96$ square feet, and the upper $8 \times 4 = 32$ square feet. The mean base is therefore $\frac{96 + 32}{2} = 64$ square feet, which, multiplied by the height, 3 feet, gives 192 cubic feet as the volume of the heap. Both these cannot be right. Is either?

Let us divide the heap into shapes that we know how to measure. There is the central parallelepiped 8 feet long, 4 feet broad, and 3 feet high. Its volume, therefore, is $8 \times 4 \times 3 = 96$ cubic feet. There are two long prisms each 8 feet long, 2 feet wide, and 3 feet high, which being put together as in Figure 19, make a parallelepiped whose volume is $8 \times 2 \times 3 = 48$ cubic feet. There are two short prisms each 4 feet long, 2 feet broad, and 3 feet high, which also being placed together form a parallelepiped whose volume is $4 \times 2 \times 3 = 24$ cubic feet. There are four pyramids, whose bases are each 2 feet by 2 feet $= 4$ square feet, and whose height is 3 feet. The volume of each is therefore $4 \times \frac{3}{3} = 4$ feet, or 16 cubic feet

for the four pyramids. These different solids make up the entire heap, whose volume is therefore 96 + 48 + 24 + 16 = 184 cubic feet.

But the error in the two systems usually adopted could have been shown in the concrete without any calculations. To take the first method: Mean length × mean breadth × height. The top length is the length of a long prism, and the bottom length is the length of the long prism and that of the bases of two pyramids, therefore the mean length is that of the long prism and of the base of one pyramid. In like manner it is clear that the mean breadth is the length of a short prism and of the base of a pyramid. If, therefore, this method be right, the heap is equal to a parallelepiped of this mean length and breadth, with a height equal to that of the heap. The models arranged as in figure 25 show such a parallelepiped, and it is made up of the central parallelepiped of the heap, the two long and the two short prisms arranged as in figure 19, and *three* pyramids arranged as in figure 23. But the heap had *four* pyramids; the parallelepiped therefore is not equal to the heap, and the method is consequently incorrect.

So also is the second method—Volume equal to mean base multiplied by height. The top base is that of the central parallelepiped of the heap. The bottom base is that of the same solid, together with those of two long and two short prisms and four pyramids. The sum of these is twice the base of the central solid, of the long prism, of the short prism, and four times that of a pyramid, so the mean base will be that of the central solid, a long prism, a short prism, and two pyramids, and this should be the base of the parallepiped of the height of the heap, whose volume should (if this method be right) equal that of the heap. That is, it would be necessary to add to figure 25 the base of another pyramid and complete the parallelepiped upon that base up to the height of the rest. To do this two more pyramids would be required, but all the constituent parts of the heap are already used, and consequently this method is wrong also.

The first method was wrong by the omission of the volume of one pyramid. This volume is equal to its base multiplied by a third of its height. Its base is equal to the difference between the extreme and mean lengths and breadths of the heap; therefore, if these differences be multiplied together, and their product by a third of the height, and this be added to the product of the first method, the true contents of the heap will be found.

These are a few illustrations of a method I venture to recommend for the preliminary teaching of mathematics. You will observe that very often it strikingly shows the intimate relations

that exist between the sciences of quantity. I would not in the first place precede these simple demonstrations by any definitions. Where necessary when a scientific word is first used I would define it, but as the definition would then be given with the thing defined bodily before the eyes of the learner, it would be more easily learnt and understood, and more indelibly fixed in the mind. But generally it is better at first to trust to the general knowledge possessed by most learners, however young, of the names of elementary forms when they see them, rather than add to the bulk of material set forth as having to be learnt.

But, to my mind, the greatest advantage of the system is that it renders the understanding of mathematical reasoning so easy as also to render easy the understanding of all other logical reasoning. It visibly puts before the eye the lines upon which all reasoning proceed. It thus increases the usefulness of mathematics as a promoter of exactness in reasoning, and assists learners in all their other studies by giving them clearer and larger powers of apprehension. It not only simplifies geometry, but makes the acquirement of all other science more easy.

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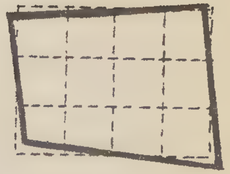

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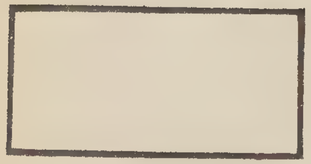

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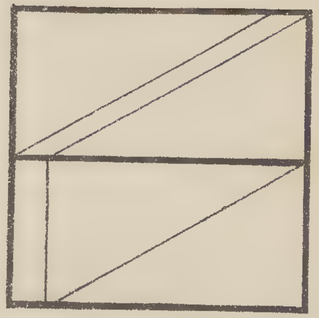

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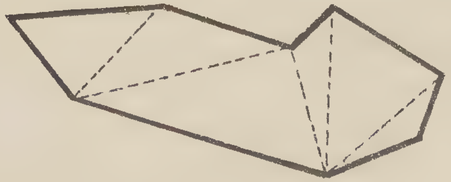

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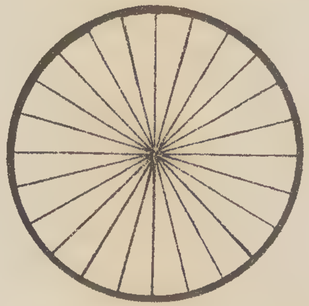

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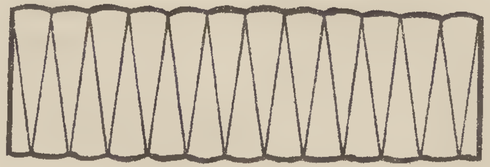

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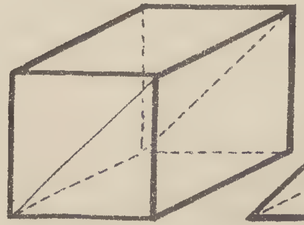

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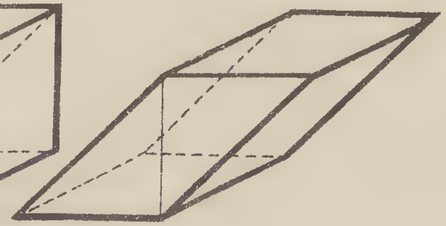

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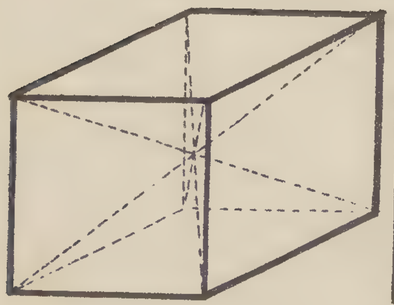

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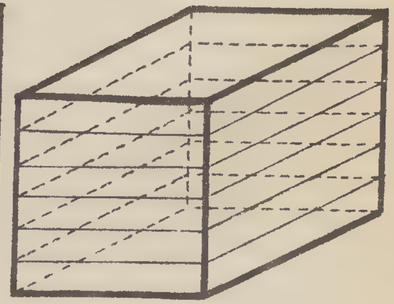

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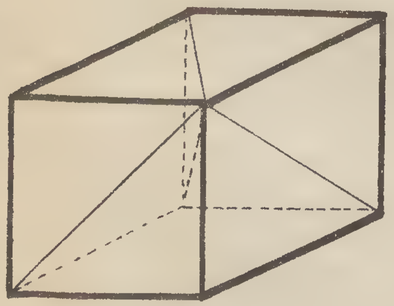

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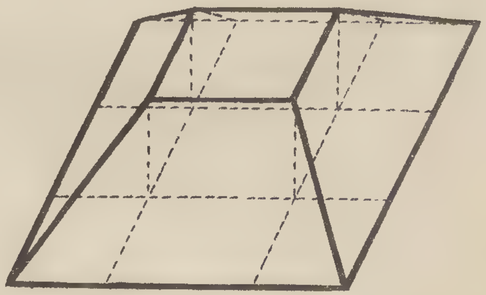

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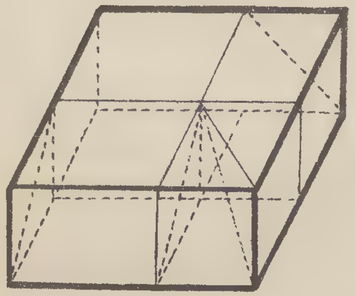


A.

ON THE AUSTRALIAN PECTENS CONFOUNDED WITH THE NEW ZEALAND *P. LATICOSTATUS*. (Gray.)

By Professor Ralph Tate, F.G.S., F.L.S., Etc.,
Corr. Memb.

The only species of the section Vola, inhabiting New Zealand-waters, is generally known under Gray's name of *P. laticostatus*, to which is referred *P. Novæ Zelandiæ*, Reeve, as a synonym; but neither names should be employed, inasmuch as the first is pre-occupied by a Lamarckian species fossil in Pliocene Strata in Italy, and the second by another New Zealand species, established by Gray.

Eastern Australia, Tasmania, and South Australia have each a species of Vola, which has been confounded with that belonging to New Zealand. The Port Jackson shell is locally known as *P. fumatus*, Reeve; the Tasmanian shell is referred by the Rev. J. E. Tenison-Woods to *P. fumatus*, which is considered by him as the same as *P. laticostatus*, he writes* :—

"I regard it as identical with *P. laticostatus*, Gray. They would have been recognised as identical long ago, but for the foregone conclusion that the common shells were necessarily different, because of the different habitat." The South Australian shell is named *P. laticostatus*, by Mr. G. F. Angas.†

Though not indifferent to the opinions of these conchologists, yet in this particular instance I consider their identifications incorrect, and surmise that they have been made without comparison of authentic specimens.

Reeve's figures and descriptions of *P. fumatus*, and *P. Novæ Zelandiæ* are of little value for the purpose of differentiation —his figures lack detail, and the deficiencies are not made good by the descriptions. As the result of a very careful comparison of an extensive series of actual specimens from each of the four geographic regions, it is my opinion that *P. fumatus* is very distinct from *P. laticostatus*, that the South Australian shell is either a local race of *P. fumatus*, or a closely related species, and the Tasmanian shell is distinct from either *P. laticostatus* or *P. fumatus*, though more allied to the former. These several species will be referred to under the names of:—

P. fumatus, for the New South Wales shell.
P. fumatus, var albus, or *P. albus*, South Australian.
P. meridionalis, Tasmanian, and
P. laticostatus for the New Zealand shell.

* Proc. Roy. Soc. Tasm. for 1877, p. 56.
† Cat. of Marine Moll. in Proc. Zool. Soc., 1865, p. 656.

All agree in having about 16 principal ribs, but differ from one another in respect of shape, relative width of ribs and furrows, and sculpture.

In the absence of figures, the measures set out in the following table will serve to indicate the differences and resemblances of shape of these shells; and though the measures are those of a single specimen of each species, yet, they are virtually composite.

TABLE OF DIMENSIONS OF CONVEX OR RIGHT VALVE IN MILLIMETRES.

—	*P. laticostatus*	*P. meridionalis*	*P. albus*	*P. fumatus*
Antero-posterior diameter	116	120	86	65
Ventro-dorsal diameter...	100	104	76	61
Depth of valve	27	27	25	21
Ventro-dorsal curve ...	120	125	102	80
Distance from umbo of the intersection of major antero-post and ventro-dorsal diameters	38	40	36	30

The differences of outline of the shell, as dependent on the latitude of the major antero-posterior diameter, may be indicated by the ratio of the radii of the ventro-dorsal diameter, taking the dorsal radius as 1, then the ratio for *P. laticostatus* and *P. meridionalis* is 1 to 1·6, and 1 to 1·63 respectively, and for *P. albus* and *P. fumatus* 1 to 1·11 and 1 to 1·03 respectively. The different degrees of convexity of the valve may be expressed in terms of the ventro-dorsal diameter and depth, taking the latter as 1, then for *P. laticostatus* the ratio is 1 to 3·7; for *P. meridionalis*, 3·85; for *P. albus*, 3·04; and for *P. fumatus*, 2·9. It is thus clear that *P. laticostatus* and *P. meridionalis* are similar in shape, but different from *P. fumatus* and its variety. Moreover, the former species are characterised by a densely lamellose ornament in the furrows, whereas the latter have the surface smooth, or striated under the lens.

The specific differences between these species may now be detailed as follows:—

P. LATICOSTATUS is distinguished by its broad, flat, smooth ribs with perpendicular sides, two and one-third times broader than the flat furrows.

P. MERIDIONALIS has the ribs convexly depressed, concentrically lamellose, and with 1, 3, or more radial sulcations; the furrows are concave, and as wide or a little wider than the ribs.

In both, the right valve is moderately convex, and broadest at about the dorsal two-fifths. In the following the convexity is much greater, and the greatest width is medial.

P. FUMATUS has the ribs roundly convex, but slightly elevated, the furrows a little narrower than the ribs; the whole surface concentrically striated under the lens, not raised into lamellae; the ribs are radiately distantly striated; external colour reddish-brown, internally white with a brown border all round. P. FUMATUS, VAR ALBUS differs in being less convex, and in colouration; the convex valve is white inside and out, the flat valve exteriorly pinkish-white, the ribs of a deeper tint, and streaked or blotched with darker colour.

P. bifidus, Menke, Moll. Nov. Holl., p. 35, 1843 (non Munster in Goldfuss Petref. Germ.) is probably conspecific.

PECTEN MERIDIONALIS. (Spec. nov.)

(*P. meridionalis.*) Brazier MS.)

Right or convex valve with about 16 radiating ribs; whole surface closely concentrically lamellose, more conspicuously so in the furrows; ribs convexly depressed, longitudinally sulcated; furrows concave, as wide or a little wider than the ribs. Exterior colour purplish-grey, pale straw about the umbo; interior colour maroon around a white central patch.

Left or flat valve closely concentrically lamellose, ribs roundly convex, furrows concave about as wide as the ribs, exterior colour purplish-grey, interior maroon.

Young shells up to 60 mills. long have the convex valve both inside and out, white with a pinkish tinge towards the margin; the flat valve is ruddy-brown exteriorly, white with ruddy-brown ribs interiorly.

Dimensions of right valve of a large specimen:—Antero-posterior diameter, 120; ventro-dorsal diameter, 104; ventro-dorsal curve, 125; greatest depth at 40 from umbo, 27 millimetres.

LOCALITIES.—Living on the shores of Tasmania. Fossil in the newer tertiary deposits at Ascot Heath, River Glenelg, Victoria. (J. Dennant!)

REMARKS ON DISTRIBUTION.

Pecten fumatus is restricted to New South Wales, whilst *P. albus* is only known from St. Vincent-Gulf and Port Lincoln in South Australia. The characters which separate these forms may not be accepted by conchologists as of specific value, and for the present I am content to regard the latter as a variety or local race of the former. So far as known, a thousand miles of coast line intervene between

their respective stations, but the exploration of the intermediate tract may possibly bring to light a connecting link, which may reasonably be expected if *albus* is a variation due to migration. However, of the many examples I have seen of both, I have not observed any other variation than that of colouration, and then only of trivial amount. *P. albus* would appear to have been introduced to the South Australian fauna in comparatively recent times, as it has not yet been found in any of the raised beaches or other Pleistocene deposits which abound throughout the southern coast line of this continent.

P. meridionalis and *P. laticostatus* are certainly closely related species, and may be the direct descendants of a common ancestor; but, nevertheless, the divergence was prior to the Pliocene Period. The former is fossilised at Ascot Heath, W. Victoria, there associated with some extinct species of mollusca, the percentage number of which indicates for the deposit an antiquity equal to that of the Wanganui Series in New Zealand, the lowest horizon at which *P. laticostatus* is found. No species of Vola is known in earlier deposits in either Australia or New Zealand.

NOTE UPON THE OCCURRENCE OF THE SYDNEY CRAWFISH, *PALINURUS HUGELLI*, ON THE COAST OF TASMANIA.

By W. Saville-Kent, F.L.S., F.Z.S., Superintendent and Inspector of Fisheries, Tasmania.

A few weeks since one of the fishmongers of the city, Mr. Jones, of Collins-street, presented me with the specimen of crawfish which I now exhibit and that was taken in the neighbourhood of the Schouten Islands. I am informed by the fishermen that they have not unfrequently captured similar specimens, but that thinking from their colour, dull brown, or olive green, there was something wrong with them, they have usually thrown them overboard. A very superficial examination sufficed to show how widely it differed from the common Tasmanian form *Palinurus Edwardsi*, and the chief between the two distinctions I will briefly enumerate. The body shield or carnpace is covered with even rows of smooth, sharp-pointed conical spines in place of the depressed hispid spines characteristic of our market species. The cervical and branchio-cardiac grooves are not conspicuously developed, but at the same time there is a deep sulcus immediately in front of the posterior margin. The beak or rostrum terminates in a very long and sharp projecting median spine, instead of with a short turned-up one as found in the Tasmanian crawfish.

The surface of the abdominal segments are comparatively smooth, being ornamented merely with scattered granules and punctæ, in place of being ornately sculptured or tuberculate, while their lateral edges or pleura are armed with seven or eight acuminate teeth instead of with two only as found in the Tasmanian type. All the points now enumerated accord with the diagnosis of the New South Wales species *Palinurus Hügelli* contained in Mr. Hassell's Catalogue of the "Australasian Stalk and Sessile-eyed Crustacea," and with which I have no hesitation in identifying it. To make more sure of this suggested identification, I remitted drawings of the more essential features of this crawfish to my brother, Mr. Acland Kent, at present residing in Sydney, asking him to compare them with the typical examples in the Sydney Museum. The comparisons instituted resulted in a full confirmation of my anticipations, and we may accordingly include Tasmania in the area of distribution of this species, and which it may be mentioned is regarded as identical with the *Palinarus tumidus*, Kirk, inhabiting North Island, New Zealand. I have much pleasure in presenting the specimen to the Society's Museum.

OBSERVATIONS ON A SUSPECTED HYBRID SPECIES OF TRUMPETER, AND UPON OTHER RARE FISH TAKEN IN TASMANIAN WATERS.

By W. Saville-Kent, F.L.S., F.Z.S.

I propose in this communication to make a few remarks upon certain varieties of fish that have been remitted me by the local fishermen within the past twelve months as varieties with which they were more or less unfamiliar.

The first specimen to which I have to draw attention was captured on the East Coast in a graball net in company with ordinary silver bastard trumpeter, and being brought to Hobart alive was kept for some time in one of the tidal ponds at the fishery establishment. When taken by the fishermen it was at once recognised by them as an unfamiliar form which could not be correctly identified with either the real trumpeter, *Latris hecateia*, or the ordinary red and silver bastard trumpeter, *Latris Forsteri*, but which combined the character of both of these familiar species in a very remarkable manner. The accompanying water-colour drawing (submitted to the meeting) taken from life, and of the natural size, will give an approximate idea of the shape,

colour, and general aspect of the living fish. The specimen did not long survive the injuries it had received in being caught; and upon its death the structural details as here recorded were accurately determined. Its total length was 21 inches, whereof the head occupied slightly less than one-fourth; the greatest depth, measuring from the centre of the spinous portion of the dorsal fin, was $6\frac{1}{2}$ inches. Its weight fresh from the water was $3\frac{3}{4}$lb., but being in an emaciated condition, 4lb. may be set down as its approximate living weight. The general colour and the distribution of the markings on the body of the fish, as observed in life, corresponded closely with those of an adult silver bastard, *Latris Forsteri*, consisting of a pearl ground with horizontal lines, and reticulations of light brown and tawny yellow that extended throughout the dorsal region to a little below the lateral line. The fins were, however, of a more pronounced yellow than those of the silver bastard, combined with a tendency to green upon the pectorals and ventrals suggestive of what obtains in the real trumpeter. There was also an entire absence of the black edging to the pectoral, candal, and hind dorsal fins that is so characteristic of the silver variety. In its general contour, and with respect to the greater portion of its anatomical details, the fish was found to agree most closely with the real trumpeter, *Latris hecateia*. Compared with that species, it coincides in the possession of seventeen rays to the anterior or spinous portion of the dorsal fin, in the number of scales, 110, developed on the lateral line, and in the presence of teeth on the vomer, though these are fewer in number than obtains in the last-named species. In the common or silver bastard trumpeter there are invariably only sixteen spinous rays in the anterior moiety of the dorsal fin; the scales along the lateral line vary from 115 to 120, and there are no teeth whatever upon the vorem.

It has been suggested to me that the individual now under discussion may be identical with the variety known by the title of the New South Wales, or New Zealand trumpeter, *Latris ciliaris*, and which represents the commercial species of the trumpeter genus in the two colonies, from whence it takes its name. Mr. R. M. Johnston, F.L.S., in his "Catalogue of Tasmanian Fishes," 1882, p. 113, expresses the opinion that this type does not exist in these waters, and that the supposed specimens of it, reported by local naturalists, were variations only of the silver bastard. Since the publication of his catalogue, Mr. Johnston, has, however, satisfied himself that the species pays occasional visits to these shores. (Proc. Roy. Soc. Tasmania, p. lxxxix, 1884), and one reputed example, taken at George's Bay, has been deposited in the Society's Museum. The leading peculiarities of the New South Wales

or New Zealand trumpeter, according to the original diagnosis, are the fewer number of scales, 84 only, upon the lateral line, and the small number, six only, of the unbranched pectoral rays. In other respects, except for the presence of an extra dorsal spine, it corresponds with the ordinary silver bastard trumpeter, *Latris Forsteri*.

It will be found on reference to the structural formulæ of the several species of trumpeter presently submitted that the fish forming the subject of this notice corresponds more closely with the real trumpeter, *L. hecateia*, than with *L. ciliaris*, though it cannot be precisely identified with any one of the three generally recognised species belonging to the genus, with which it has now been compared. It may be mentioned here that two additional species are included in the trumpeter genus by Castelnau, viz., *Latris bilineata*, and *L. inornata*, while a third *L. Ramsayi*, has been described by J. D. Ogilby. The structural characters of these three species, however, agree so closely with those of the silver bastard, *L. Forsteri*, the differences upon which they have been founded, relating chiefly to colour, that they are regarded by many icthyologists as probably local variations only of that species. With some authorities the fish, now introduced, would probably be accepted as the type of a new species, and as a matter of fact its structural characteristics, more particularly with relation to its dentition, invest it with more substantial qualifications for such a distinction, than are found in either of the three supplimentary species, last enumerated, established by Castelnau and Ogilby. Were this variety obtainable in any quantity and its structural formula as here recorded found to be constant, I should be inclined also to associate it with a distinct specific title. Taking into account, however, its occurrence as an exceptional specimen, and giving full value to the remarkable manner in which it combines the characteristics of both the real and the silver bastard trumpeter, I find it difficult to avoid the conclusion that it represents an accidental case of hybridism between these two species. Parallel instances of hybridism, as is now generally known, naturally occur or may be brought about by artificial means among diverse species of salmonidæ. It may be further cited as a circumstance in favour of this interpretation that the breeding seasons of the silver bastard, and of the real trumpeter, May to July, and July and August, overlap one another, so that the spawn of the one might be fertilised by the milt of the other. The greatest obstacle to this proposed interpretation is, to my mind, associated with the character of the dentition, the number of vomerine teeth, two only, being so considerably fewer than those of *Latris hecateia*. It might at the same time be anticipated that the interbreeding of two allied

species, the one as in *L. Forsteri* being altogether destitute of vomerine teeth, and the other represented by the real trumpeter having six or eight such teeth, would result in an intermediate form in which teeth were present, but less numerically developed than in *Latris hecateia*.

The precise affinities of the three generally recognised species of the genus *Latris*, both among themselves, and with relation to the suspected hybrid now described, will be most readily comprehended by an examination of their respective structural formulæ when placed in juxtaposition as in the accompanying schedule:—

—	D.	P.	A.	L. lat.	Vom'rine teeth.
L. hecateia—Real trumpeter ..	17:1·36-38	9br·8-9s	3·28-30	110	6-8
L. Forsteri—Silver bastard ..	16:1·37-42	9·10br·8-9s	3·33-38	115-120	None
L. ciliaris—N.S.W. trumpeter..	17:39	9br·6s	3·32	84	None
L. sp.—Hybrid (?)	17:1,39	9br·9s	3·32	110	2

Concerning one of the species enumerated in the foregoing schedule, viz., the so-called New South Wales or New Zealand trumpeter, *Latris ciliaris*, it is, I think, very desirable that more extensive investigations should be made. The structural formula for this species, as above cited, is a transcript of that given in Dr. Gunther's "Catalogue of Fishes," vol. ii, p. 86, and reproduced by other more recent authorities. My friend, Mr. R. M. Johnston, however, informs me that an example has passed through his hands in which there were as many as eight instead of six simple pectoral rays, and on making a careful examination, in company with Mr. Morton, of the type specimen in thə Museum, we found that it has only sixteen instead of seventeen spinous rays in the dorsal fin. It consequently follows that if the two specimens just referred to are to be accepted as *bona-fide* examples of *Latris ciliaris*, the claims of this accredited species to an independent specific status rest upon an exceedingly slender basis, and, in fact, solely on the number of scales developed along the lateral line of the body, all the remaining structural details agreeing essentially with those of the ordinary silver bastard trumpeter, *Latris Forsteri*. In order to more fully investigate this matter, and to, if possible, arrive at a satisfactory solution of the problem, Mr. Morton is taking steps to procure genuine examples of *Latris ciliaris* from Sydney. And at a future meeting of this Society I shall hope to report upon the results of a more exhausted comparison between the two species that will then be rendered practical.

In the possible event of this at present suspected hybrid variety being found to have substantial claims for recognition as an independent species, I would propose to bestow upon it

the title of *Latris Mortoni*, such specific title being associated with the name of Mr. Alexander Morton, the curator of the Tasmanian Museum, to whom I am indebted for much assistance in working up the literature of the species allied to the varieties described in this communication.

The second specimen to which I have to draw attention is a representative of the genus *Clinus*, belonging to the family Blenüdæ, and including a number of shore-frequenting fishes which rarely exceed a length of a few inches. A single species, *Clinus despicillatus*, Richards, is recorded in Mr. Johnston's "Catalogue of Tasmanian Fishes." It attains to a length of four or five inches, and is one of the forms popularly known as "bullies" that may be abundantly obtained in rock pools or lurking under stones at low water. A second Australian (Port Phillip) species, *Clinus marmoratus*, Klunz.—length 15 centimetres, or say 7 inches—is included in the supplement to Macleay's "Catalogue of Australian Fishes, 1884." Upwards of twenty additional species of the genus are described in Dr. Gunther's "Universal Catalogue of Fishes." A large portion of these are inhabitants of the seas around the Cape of Good Hope, and the remainder inhabit the American coast line and the Chinese Seas. The specimen I have to introduce is remarkable for its comparatively large size—14 inches—and so far as I have been able to determine it differs in several essential structural points from any of the various species hitherto described. An approximate idea of the dimensions, general aspect, and the diversified tints of the living fish may be obtained in reference to the water-coloured drawing from life herewith submitted. These together with the essential structural details are further embodied in the following diagnosis :—

CLINUS JOHNSTONI. Nov. Sp.

D 2-3· 32-33· 5 | A 2· 25-26 | V 1· 3.

Height of body, contained about four times, the length of the head about five times, in the total length; snout, conical, the lower jaw somewhat prominent; a large erect foliacous branched tentacle developed above each orbit, a similarly large tentacle, with six slender subulate ramifications, developed from each nostril, and directed forwards. A single row of isolated, incurved, conical teeth, developed throughout the outer edge of the upper jaw; a crescentic patch of thickly set, minute, villiform teeth, developed upon the inner edge of the premaxillæ, and a corresponding patch of smaller dimensions developed on the vomer, no teeth on the palatines; a series of six or seven isolated conical teeth, of larger size than those of the upper jaw, developed along each side of the lower jaw, the symphasis of the mandibular region occupied by a crescentic patch of closely approximated small sized teeth of

the same character. The two or three anterior dorsal spines remote from, but connected by membrane with the succeeding ones; the five jointed rays of the posterior portion of the dorsal fin about one-third longer than those of the spinous portion, connected posteriorly with the candal. Colour in life, ground cream yellow, with spots and markings of crimson, grey and purple. These most conspicuously developed in the form of seven vertical bands, broadest superiorily and which extend from the upper edge of the dorsal fin, across the body, the five posterior bands terminating on the lower edge of the anal fin. A series of similarly coloured streaks radiating from the orbit, and forming a reticulated pattern on the cheeks and opercula; caudal, pectoral, and ventral fins, barred and spotted with crimson. Length, 14 inches. Habitat., Tasmania, Adventure Bay.

The specimen now described was captured in a graball net in Adventure Bay. It was kept alive for some time in one of the tanks at the fishery, and which afforded an opportunity of making the notes and drawing submitted, concerning its natural colours and aspect. It unfortunately received injuries from the net, which ultimately mortified and caused its death. On proceeding to examine it structurally, some difficulty was, in the first place, experienced in assigning it to the genus *Clinus*, in consequence of there being only two rays to the partially isolated anterior portion of the dorsal fin. In all other known species of the genus three appear to be the normal and invariable number. On examining the alcoholic collection in the Tasmanian Museum, I had the good fortune to discover a second specimen of this fish. No history or record was attached to it, and doubts were expressed as to its being a Tasmanian species. These doubts may now be set aside. On comparing the two specimens it was found that the Museum example possessed the normal number of three rays to the anterior segment of the dorsal fin, It was at the same time imperfect in the ventral fins, only a single soft ray being developed on the left, and two on the right of these appendages in place of three. This deficiency may probably be accounted for by an accident in early life. In all other respects the two specimens completely corresponded. Respecting the affinities of the species under discussion, the size alone separates it distinctly from the two relatively small Australian representatives of the genus *Clinus despicillatus* and *C. marmoratus*, hitherto described. There are other more essential points, however, in which it not only differs from these, but so far as I have been able to ascertain from any of the twenty or more species that have been elsewhere described. The development of large tentacular processes in connection with the nostrils, equal in

size to, but different in character from those over the orbits is recorded of no other known species, and may be accepted, I think, as a reliable diagnostic character. From their large size and projecting character, it may be anticipated that these nostril tentacula fulfil the part of efficient tactile organs, or taking their origin from the olfactory chamber may be closely associated with the sense of smell. In the numerous European species of the allied genus, *Blennius*, with which I am familiar, I have always found the form and proportions of the tentacular appendages to be a constant factor, and in my examination of a number of examples of the indigenous *Clinus despicillatus* for the purposes of comparison, I have found no variation in these elements. It may be mentioned here that although nostril tentacula are not included in the diagnosis given of the last-named species, they exist in a rudimentary condition, and may be observed in life as a minute bi- or tri-furcate filament developed from the projecting tube of the nostril. In spirit-preserved examples it shrinks up so as to be scarcely visible. An additional point of divergence with relation to *Clinus despicillatus* that has been established through the examination of a considerable number of this species, is the circumstance that while in this type the number of soft or jointed rays to the hinder extremity of the dorsal fin is invariably four only, in both examples of the variety now introduced there are five such rays.

It appearing desirable that a new specific title should be associated with the from described in this communication, I propose, providing that further investigations should fail to identify it with any previously named type, to distinguish it by the title of *Clinus Johnstoni.* The scientific name suggested, I need scarcely add, is in honour of a well-known Fellow of the Society, Mr. R. M. Johnston, F.L.S., to whom science is so much indebted for the already advanced state of our knowledge concerning the fish fauna of this colony.

The third species of fish which I exhibit on this occasion I had anticipated, on account of the scaly covering of the several vertical fins, to belong to the group distinguished by the title of the *Squammipinnes* or " scale-finned" fishes. Without examining it closely I set it aside at the time as being, in all probability, identical with *Scorpis Georgianus*, the single known species of that group that has so far been captured, though very rarely, in Tasmanian waters. On proceeding very recently to glance through the structural details of the fish, it was found, however, that it could not be referred to the genus *Scorpis* or to any other of the typical Squammipinnes but to the tribe of the Pomacentridæ, many of whose members bear an external resemblance to those of the first-named group, but, at the same time differ from them in several important

internal anatomical details. Among the Pomacentridæ, this fish finds its place in the genus *Glyphidodon*, and has been identified by my friend, Mr. R. M. Johnston, with *Glyphidodon Victoriæ*, or the so-called "rock perch" of the Melbourne fishermen. As a species and genus it represents the first example recorded from Tasmanian waters. The specimen exhibited was captured on the North Coast, being taken in a graball net by the George Town fishermen. The structural formula, as given by Dr. Gunther, Ann. and Mag., Nat. Hist., 1873, vol. xi., p. 115, is as follows:—

GLYPHIDODON VICTORIÆ, Gunther.

D. 13-17. A. 2-15 | L. Lat. 30. L. Transv. 4-10.

Over fifty additional species of the genus have been described, the majority being inhabitants of the hotter Tropical Seas.

REFERENCE LIST OF THE TERTIARY FOSSILS OF TASMANIA.

BY ROBT. M. JOHNSTON, F.L.S.

So many additions have been made to the list of Tertiary fossils of Tasmania during the last seven years that it is now very desirable that a Reference List, complete to date, should be placed at the disposal of all those who may wish to make themselves acquainted with the Tertiary fossils of this island. I have, with this object in view, prepared the following Reference List, which I hope will be of some advantage to the members of this Society, as well as to geologists generally.

The list embraces about 382 species, of which the following is an abstract:—

	Tertiary.
Plantæ	114
Rhizopoda	14
Actinozoa	16
Echinodermata	4
Polyzoa...	9
Crustacea	2
Brachiopoda	14
Pelecypoda	60
Gasteropoda	125
Cephalopoda	1
Pisces	3
Marsupialia	3
	365

Post Tertiary.

Gasteropoda	6
Marsupialia	8
Rodentia	2
	17

The following is a summary of the number of species described by various authors:—

Tertiary Species.

Tenison-Woods	88 species.
R. M. Johnston	52 „
R. Tate	35 „
Ettingshausen	29 „
M'Coy	13 „
Duncan	12 „
Busk...	7 „
Various authors	60 „
Undetermined	69 „
	365

Post Tertiary.

Various authors	17 species.

TERTIARY.

Plantæ.

DESCRIBED FROM LEAVES BY WRITING AND FIGURES.

1. Lomaria primæva. *R. M. Johnston.* (P.) *Locality*, Tas., Stevenson's Bend, Launceston. *Reference*, Johnston, Proc. Roy. Soc. Tas., Aug. 1874, fig. 3-6.
2. Trichomanides Tasmanica. *R. M. Johnston.* (P.) *Locality*, Tas., Breadalbane. *Reference*, Johnston, Proc. Roy. Soc. Tas., 1874, figs. 5-6.
3. Pteris (?) Belli. *R. M. Johnston.* (P.) *Locality*, Tas., Turritella Group, Table Cape. *Reference.* Proc. Roy. Soc. Tas., 1886.
4. Myrica Eyeri. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *Reference*, E.J.
5. Betula Derwentensis. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *Reference*, E.J.
6. Betula Launcestonensis. *R. M. Johnston.* (P.) *Locality*, Tas., Launceston. *Reference*, Proc. Roy. Soc. Tas., p. 1873, fig. 1.
7. Alnus. Muelleri. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
8. Quercus Tasmanicus. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
9. Quercus Bischoffensis. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *Reference*, Johnston, Proc. Roy. Soc. Tas., p. 324, fig. 2-3, 1885.
10. Fagus Risdoniana. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
11. Salix Cormickii. *Ettingshausen.* (P.) *Locality*, Tas., Der went. *References*, E.J.

12. Cinnamomum polymorphoides. *M'Coy.* (P.) *Locality*, Tas., Stevenson's Bend, Launceston, Vic. *References*, M'Coy, Geol. Survey Vic., Dec. 4, p. 40. Johnston, Proc. Roy. Soc. Tas., fig. 2, 1874.
13. Cinnamomum Woodwardii. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
14. Cinnamomum Hobartianum. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
15. Laurus Sprentii. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *References*, Johnston, Proc. Roy. Soc. Tas., p. 324, fig. ii-1, 1885.
16. Dryandroides Johnstonii. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
17. Apocynophyllum microphyllum. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
18. Apocynophyllum travertinum. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
19. Echitonium obscurum. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
20. Cordia Tasmanica. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
21. Premna Drummondi. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
22. Sapotacites oligoneuris. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
23. Sapotacites achrasoides. *Ettingshausen.* (P.) Locality, Tas., Derwent. *References*, E.J.
24. Ceratopetalum Woodii. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
25. Ceratopetalum præ-arbutoides. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
26. Sapindus Tasmanicus. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
27. Eucalyptus Kayseri. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *Reference*, Johnston, Proc. Roy. Soc. Tas.. p. 323, fig. i-1, 1885.
28. Eucalyptus Milligani. *R. M. Johnston.* (P.) *Locality*, Tas., Macquarie Harbour (?) *Reference*, Johnston, Proc. Roy. Soc. Tas., p. 336, fig. ii-4, 1885.
29. Cassia Flindersi. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
30. Ulmus Tasmanicus. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *Reference*, Johnston, Proc. Roy. Soc. Tas., p. 325, fig. i-4, 1885.
31. Coprosma præ-cuspidifolia. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
33. Taxites Thureaui. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *Reference*, Johnston, Proc. Roy. Soc. Tas., p. 336, 1885.
34. Cycadites microphylla. *R. M. Johnston.* (P.) *Locality*, Tas., Waratah. *Reference*, Johnston, Proc. Roy. Soc. Tas., p. 2, fig. 8, 1885.
35. Phyllites populiformis. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.

36. Phyllites ficiformis. *Ettingshausen.* (P.) *Localitu*, Tas. Derwent. *References*, E.J.
37. Phyllites juglandiformis. *Ettingshausen.* (P.) *Locality* Tas., Derwent. *References*, E.J.
38. Phyllites ligustroides. *Ettingshausen.* (P.) *Locality*, Tas Derwent. *References*, E.J.
39. Phyllites pyriformis. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
40. Phyllites phaseolites. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
41. Phyllites sophoræformis. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.
42. Phyllites mimosæformis. *Ettingshausen.* (P.) *Locality*, Tas., Derwent. *References*, E.J.

LEAVES DESCRIBED BY FIGURES ONLY.

43. Betula Launcestonensis. *R. M. Johnston.* Fig. 1. Johnston Launceston Tertiary Basin. Proc. Roy. Soc. Tas., 1873.

44.	Phyllites	sp.	Fig. 2.	,,
45.	,,	sp.	Fig. 3.	,,
46.	,,	sp.	Fig. 4.	,,
47.	,,	sp.	Fig. 6.	,,
48.	,,	sp.	Fig. 7.	,,
49.	,,	sp.	Fig. 8.	,,
50.	,,	sp.	Fig. 9.	,,
51.	,,	sp. (Betula).	Fig. 12.	,,
52.	,,	sp.	Fig. 15.	,,
53.	,,	sp.	Fig. 16.	,,
54.	,,	sp.	Fig. 17.	,,
55.	,,	sp.	Fig. 18.	,,
56.	,,	sp. (Betula).	Fig. 19.	,,
57.	,,	sp.	Fig. 21.	,,
58.	,,	sp.	Fig. 22.	,,
59.	,,	sp.	Fig. 23.	,,
60.	,,	sp.	Fig. 28.	,,
61.	,,	sp.	Fig. 7.	1874
62.	,,	sp.	Fig. 8.	,,
63.	,,	sp.	Fig. 9.	,,
64.	,,	sp.	Fig. 14.	,,
65.	,,	sp.	Fig. 3.	Est'y. of Derwent, 1881 Proc. Roy. Soc. Tas., 1881. Johnston.
66.	,,	sp.	Fig. 7.	,,
67.	,,	sp.	Fig. 9.	,,
68.	,,	sp.	Fig. 17.	,,
69.	,,	sp.	Fig. 18.	,,
70.	,,	sp.	Fig. 19.	,,
71.	,,	sp.	Fig. 21.	,,
72.	,,	sp.	Fig. 24.	,,
73.	,,	sp.	Fig. 32.	,,
74.	,,	sp.	Fig. 33.	,,
75.	,,	sp.	Pt. I., fig. 5.	Waratah, 1885

					Proc. Roy. Soc., Tas., 1885. Johnston.
76.	„	sp.	Pl. I., fig. 6.		„
77.	„	sp.	Pl. I., fig. 7		„
78.	„	sp.	Pl. II., fig. 2.		„
79.	„	sp.	Pl. II., fig. 3.		„
80.	„	sp.	Fig. 1.	Leaf forms found embedded in the Turritella sandstone beds at Table Cape, associated with the characteristic marine shells, *T. Warburtonii* (Woods.) *Panopœa Agnewi*, etc. Proc. Roy. Soc. Tas., 1886 (Johnston.)	
81.	„	sp.	Fig. 2.		
82.	„	sp.	Fig. 3.		
83.	„	sp.	Fig. 4.		
84.	„	sp.	Fig. 5.		
85.	„	sp.	Fig. 6.		
86.	„	sp.	Fig. 8.		
87.	„	sp.	Fig. 10.		
88.	„	sp.	Fig. 11.		
89.	„	sp.	Fig. 12.		
90.	„	sp.	Fig. 13.		

Fruits Described by Writing and Figures.

91. Conchotheca turgida. *F. V. Mueller.* (P.) *Locality*, Tas., Beaconsfield, Geilston ; Vic., Nittingbool, River Tangil ; Qu., Darling Downs. *References*, Mueller, New Veg. Foss, 1874, p. 24 t. 10, figs. 5-12.

92. Penteune Allporti (M.S.). *F. V. Mueller.* (P.) *Locality*, Tas., Geilston, Beaconsfield ; Vic., Nittingbool. *References*, Johnston, Proc. Roy. Soc. Tas., 1879, p. 85.

93. Platycoila Sullivani. *F. V. Mueller.* (P.) *Locality*, Tas., Geilston, Breadalbane, Beaconsfield ; Vic., Nittingbool. *References*, Mueller, New Veg. Foss., 1874, p. 23 t. 9, figs. 5-9.

94. Plesiocapparis leptocelyphus. *F. V. Mueller.* (P.) *Locality*, Tas., Geilston, Beaconsfield ; N.S.W., Gulgong. *References*, Mueller, New Veg. Foss., 1883, p. 17, figs. 1-2. Johnston, Proc. Roy. Soc. Tas., p. 27, 18—, 1.

95. Rhytidotheca pleioclinis. *F. V. Mueller.* (P.) *Locality*, Tas., Breadalbane ; Vic., Nittingbool. *References*, F. V. Mueller, New Veg. Foss., 1883, pl. 17, figs. 1-2.

96. Cordia Tasmanica. *Ettingshausen.* (P.) *Locality*, Tas., Muddy Creek, Derwent. *References*, Ettings. Tertiarflora Austral, 1883, p. 34, pl. 5, figs. 3-5. Johnston, Proc. Roy. Soc. Tas., 1881, figs. 42-43 ; Ibid, Proc. Roy. Soc. Tas., 1873, fig. 14.

97. Elæocarpus Bassi. *Ettingshausen. Locality*, Tas., Beaconsfield. *References*, Ettings. Tertiarflora Austral, 1883, p. 39, pl. 6, figs. 9-11. Johnston, Proc. Roy. Soc. Tas., 1881, fig. 57.

98. Carpolithes gaertnerioides. *Ettingshausen. Locality*, Tas., Derwent. *References*, Ettings. Tertiarflora Austral, 1883, p. 45, pl. 6, fig. 13. Johnston, Proc. Roy. Soc. Tas., 1881, fig. 34, A.B.

99. Carpolithes Risdonianus. *Ettingshausen. Locality*, Tas., Geilston. *References*, Ettings. Tertiarflora Austral, 1882 p. 46, pl. 6, fig. 14.

100. Spondylostrobus Smythii. *F. V. Mueller.* *Locality*, Tas., Beaconsfield, Breadalbane, Launceston ; Vic., Tangil R., Beechworth ; N.S.W., Orange. *References*, Mueller, New Veg. Foss., 1874, pp. 8-9, pl. 1, fig. 1-8 ; Ibid, 1883, p. 13-14, fig. 5A-5B. Johnston, Proc. Roy. Soc. Tas., 188 , p. 27.
101. Araucaria Johnstonii. *F. V. Mueller.* *Locality*, Tas., Geilston. *References*, Mueller's New Veg. Foss., 1883, pp. 16-19, pl. 18, figs. 1-4. Johnston, Proc. Roy. Soc. Tas., 1881, figs. 37-37A-376.

Fruits Figured, but not Described.

102.	Carpolithes sp. August, 1874.	Fig. 7.	Johnston, Proc. Roy. Soc. Tas.,	Launceston Tertiary Basin.	
103.	Carpolithes sp.	Fig. 11.	,,	,,	
104.	,, sp.	Fig. 13.	,,	,,	
105.	,, sp.	Fig. 15.	,,	,,	
106.	,, sp.	Figs. 38-39.	,,	1881	,,
107.	,, sp.	Figs. 51-53.	,,		Geilston
108.	,, sp.	Figs. 54-55.	,,		,,
109.	,, sp.	Fig. 58.	,,		Breadalbane
110.	,, sp.	Fig. 61.	,,		Beaconsfield
111.	,, sp.	Fig. 62.	,,		,,

Figures of Sections of Fossil Wood.

112.	Sections of Fossil Pine. Soc. Tas., August, 1874.	Figs. 16-18.	Johnston, Proc. Roy.	Launceston.
113.	,, (Banksia.)	Figs. 10-13.	,,	Corra Lynn
114.	,, (Exog. Wood.)	Figs. 19-20.	,,	,,
115.	,, ,,	Figs. 14-15.	,,	Breadalbane lignite

Animalia

Rhizopoda.

1.	Biloculina sp.	(P).	*Locality*,	Table Cape, Tas.
2.	Triloculina sp.	,,	,,	,,
3.	Quinqueloculina sp.	,,	,,	,,
4.	Discorbina Bertheloti d'Orb.	(P).	R.E. 127.	Mt. Gambier, S.A.
5.	Nummulina sp.	,,		Table Cape, Tas.
6.	Marginulina sp.	,,		,,
7.	Orbulina sp.	,,		,,
8.	Dentalina sp.	,,		,,
9	Alveolina sp.	,,		,,
10.	Polymorphina sp.	,,		,,
11.	Cassidulina sp.	,,		,,
12.	Nonionina sp.	,,		,,
13.	Textularia agglutinans d'Orb.	R.E. 132	,,	Mt. Gambier, S.A.
14.	,, pygmæa ,,	R.E. 132		,,

Actinozoa.

15. Antillia lens. *Duncan.* (P.) Table Cape, Tas.; Hamilton, Vic. R.E. 133.
16. Balanophyllia Australiens. *Duncan.* (P.) Table Cape, Tas.; Muddy Creek, Vic. R.E. 134.

17. Conotrochus Maccoyi. *Duncan.* (P.) Table Cape, Tas.; Cape Otway, Vic. R.E. 135.
18. Dendrophyllia Duncani. *Ten. Woods.* (P.) Table Cape, Tas. R.E. 135.
19. ,, epithecata. *Duncan.* (P.) ,, R.E. 135
20. Flabellum Duncani. *Ten. Woods.* (P.) ,, R.E. 136
21. ,, Gambierense. *Duncan.* (P.) ,, Mt. Gambier, S.A.; Cape Otway, Vic. R.E. 136.
22. Flabellum Victoriæ. *Duncan.* (P.) Table Cape, Tas.; Muddy Creek, Hobson's Bay, Schnapper Point, Vic. R.E. 136.
23. Palæoseris Woodsi. *Duncan.* (P.) Table Cape, Tas.; Muddy Creek, Vic. R.E. 136.
24. Heliastræa Tasmaniensis. *Duncan.* (P.) Table Cape, Tas. R.E. 136.
25. Placotrochus deltoideus. *Duncan.* (P.) Table Cape, Tas.; Muddy Creek, Schnapper Point, Gellibrand River, Vic. R.E. 136.
26. Placotrochus elongatus. *Duncan.* (P.) Table Cape, Tas.; Muddy Creek, Aire River, Schnapper Point, Cape Otway, Vic. R.E. 136.
27. Sphænotrochus excisus. *Duncan.* (P.) Table Cape, Tas.; Hamilton, Schnapper Point, Vic. R.E. 137.
28. Thamnastræa sera. *Duncan.* (P.) Table Cape, Tas. R.E. 137.
29. Thamnastræa Tasmaniensis. *Woods.* (P.) Table Cape, Tas. R.A. 137.
30. Deltocyathus viola. *Woods-Duncan.* (P.) Table Cape, Tas.; Hamilton, Vic. *T. Woods.*

Echinodermata.

31. Lovenia Forbesi var. Woodsii. *Etheridge, Jun.* (P.) Table Cape, Tas.; Murray Cliffs, Mount Gambier, S.A.; Hamilton, Mordialloc, Vic. R.E. 141.
32. Micraster brevistella. *Laube.* (P.) Table Cape, Tas.; Murray Cliffs, S.A. R.E. 142.
33. Micraster Etheridgei. *R. M. Johnston.* (P.) Table Cape, Tas. R.E. 142, R.J. 64.
34. Cidaris (?) sp. (P.) Table Cape, Tas.

Polyzoa.

35. Cellepora Gambierensis. *Busk.* (P.) Table Cape, Tas.; Mt. Gambier, Murray Cliffs, S.A.; Spring Ck., Vic. R.E. 145, R.J., 90F.
36. Cellepora hemisphærica. *Busk.* (P.) Table Cape, Tas.; Mt. Gambier, S.A. R.E. 145, R.J. 90F.
37. Cellepora nummularia. *Busk.* (P.) Table Cape, Tas.; Mt. Gambier, S.A.; Muddy Ck., Vic. R.E. 145, R.J. 90F.
38. Cellepora spongiosa. *Busk.* (P.) Table Cape, Tas.; Mt. Gambier, S.A. R.E. 146, R.J. 90F.
39. Lepralia sp. (P.) Table Cape, Cape Green, Tas.
40. Pustulipora ramosa. *Ten. Woods.* (P.) Table Cape, Tas R.J. 90F.
41. Retepora sp. (P.) Table Cape, Tas. R.J. 90F.

42. Salicornaria sinuosa. *Hassal.* (P.) Table Cape, Tas.; Mt. Gambier, Murray Cliffs, S.A.; Muddy Ck., Vic. R.E. 150.
42a. Buskia typica. *T. Woods.* (P.) Table Cape.

Crustacea.

43. Cypris Alburyana. *R. M. Johnston.* (P.) Geilston, Tas. Johnston, Proc. Roy. Soc. Tas., 1884, p. 224.
44. Balanus amphitrite. *Darwin.* (P.) Table Cape, Tas.

Brachiopoda.

45. Terebratula vitreoides. *Ten. Woods.* (P.) Table Cape, Tas.; Middle Murravian, S.A. R.E. 152, R.T. 8-5.
46. Waldheimia Garribaldiana. *Davidson.* (P.) Table Cape, Tas.; Murray Cliffs, S.A.; Geelong, Vic. R.E. 152, R.J. 6-90A, R.T. 11-1.
47. Waldheimia furcata. *Tate.* (P.) Table Cape, Tas.; Aldinga, S.A. R.T. 7-2, R.Jc. 223.
48. Waldheimia Johnstoniana. *Tate.* (P.) Table Cape, Tas.; Aldinga, S.A. R.T. 8-9, R.J. c. 223.
49. Waldheimia grandis. *T. Woods.* (P.) Table Cape, Cape Green, Tas.; Murray Cliffs, Mt. Gambier, S.A. R.T. 11-3, R.J. c. 223, R.E. 152.
50. Waldheimia Taylori. *Etheridge.* (P.) Table Cape, Tas.; Murray Cliffs, S.A. R.E. 152, R.T. 11-2, R.J. c. 223.
51. Waldheimia Corioensis. *M'Coy.* (P.) Table Cape, Tas.; Muddy Ck., Corio Bay, Jan Juc, Vic. R.E. 152, R.T. 9-4-7, R.J. c. 223.
52. Waldheimia pectoralis. *Tate.* (P.) Table Cape, Tas.; Aldinga, S.A. R.T. 7-1, R.J. c. 223.
53. Terebratulina Scoulari. *Tate.* (P.) Table Cape, Tas.; Aldinga, Yorke's Peninsula, S.A.; Muddy Ck., Morgan, Vic. R.T. 8-3, R.J. c. 223.
54. Terebratulina lenticularis. *Tate.* (P.) Table Cape, Tas.; Aldinga, Yorke's Peninsula, S.A. R.T. 7-4, R.J. c. 223.
55. Terebratulina triangularis. *Tate.* (P.) Table Cape, Tas.; Aldinga, Bunda Cliffs, S.A. R.T. 8-7, R.J. c. 223.
56. Terebratella Tepperi. *Tate.* (P.) Table Cape, Tas.; Ardrossan, S.A. R.T. 9-8, R.J. c. 223.
57. Terebratella Woodsii. *Tate.* (P.) Table Cape, Tas. R.T. 9-10, R.J. c. 223.
58. Rhynchonella squamosa. *Hutton.* (P.) (*R. lucida*, M'Coy.) Table Cape, Tas.; Aldinga, Muloowurtie, Stansbury, Salem, S.A.; Muddy Ck., Vic.; Oamaru Formation (Eocene), Broken River, New Zealand. R.E. 151, R.T. 9-9, R.J. b. 90 d.

Pelecypoda (Lamellibranchiata).

59. Anodonta Tasmanica, *Etheridge, Jr.* (P.) Tamar, Launceston, Tas. Etheridge, Proc. Roy. Soc. Tas., 1880, p. 23, figs. 3-4.
60. Arca pseudonavicularis. *Tate.* (P.) Table Cape, Tas.; Adelaide, S.A. T. 9-8.
61. Barbatia celleporacea. *Tate.* (P.) Table Cape, Tas.; Muddy Ck., Schnapper Pt., Vic. T. 10-10.

62. Chamostrea crassa. *Tate.* (P.) Table Cape, Tas. Proc. Roy. Soc. Tas., 1884, p. 228.*
63. Cytherea eburnea. *Tate.* (P.) Table Cape, Tas. (Tate.)
64. Cytherea sp. ind. (P.) Table Cape, Tas. (Tate.)
65. Cardium septuagenarium. *Tate.* (P. Table Cape. Tas.; Bird Rock, Vic. R.E. 153, M'Coy V., t. 44, fig. 1.
66. Cardita gracillicosta. *Ten. Woods.* (P.) Table Cape, Tas.
67. " T.W., 60, R.Jc., 90c.; R.E. 153.
68. " Tasmanica. *Tate.* (P.) Table Cape, Tas. T. 12-13
69. " trigonalis. *Tate* (P.) Table Cape, Tas.; Aldinga, S.A. T. 2-1.
70. Chama lamellifera. *Ten. Woods.* (P.) Table Tas. R.E. 153, T.W. 61, R.Jb. 90.
71. Chione cainozoica. *Ten. Woods.* (P.) Table Cape, Tas. R.E. 153, T.W. 61, R.Jb. 90.
72. Chione propinqua. *Ten. Woods.* (P.) Table Cape, Tas. R.E. 153, T.W. 61, R.Jb. 90.
73. Chione Allporti. *Ten. Woods.* (P.) Table Cape, Tas. R.E. 158, T.W. 1876, p. 26, R.Jb. 90.
74. Chione sp. ind. (P.) Table Cape, Tas.
75. Chione hormophora. *Tate.* (P.) Table Cape, Tas. Proc. Roy. Soc. Tas., 1884, p. 230.
76. Chione dimorphophylla. *Tate.* (P.) Table Cape, Tas. Proc. Roy. Soc. Tas., 1884, p. 230.
77. Corbula ephamilla. *Tate.* (P.) (*C. sulcata*, Woods.) Table Cape, Tas.; Schnapper Point, Vic.
78. Crassatella aphrodina. *Ten. Woods.* (P.) Table Cape, Tas. R.E. 154, T.W. 1876, p. 17-24, R.J. 190, T. p. 54.
79. Crassatella oblonga. *Ten. Woods.* (P.) Table Cape, Tas.; R.E. 154, T.W. 1876, p. 17-24, R.J. 190, T.P. 53.
80. Crassatella astartiformis. *Tate.* (M.S.) (P.) Table Cape, Tas. (Tate.)
81. Cucullea Corioensis. *M'Coy.* (P.) Table Cape, Tas.; Corio Bay, Mordialloc, Mount Martha, Vic.
82. Dosinia Johnstoni. *Tate.* (P.) (M.S.) Table Cape, Tas. (Tate.)
83. Diplodonta subquadrata. *Tate.* (P.) Table Cape, Flinders Isd., Tas. (Tate.)
84. Gouldia lamellata. *Tate.* (P.) Table Cape, Tas. ? Aldinga, Adelaide, S.A. T. 2-17.
85. Humphreyia sp. ind. (P.) Table Cape, Tas.
86. Lima Bassii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 60, R.J. 6-90, T. 5-8.
87. Lima squamosa. *Ten. Woods.* (M.S.) (P.) Table Cape, Tas. ? T.W. 60, R.J. 6-90, T. 5-8.
88. Lima Jeffreysiana. *Tate.* (P.) (*L. subauriculata*, Woods.) Table Cape. Tate, Proc. Roy. Soc. Tas., 1884, p. 213. T. 4-8, R.E. 155, T.W. 61, R.J. 6-90.
89. Limea transenna. *Tate.* (P.) (*Cucullea minuta*, Johnston?) Table Cape, Tas.; Mt. Gambier, S.A.; Muddy Ck., Vic. R.Ja., T. 9-6.
90. Limopsis aurita. *Brocchi.* (P.) Table Cape, Tas.; Geelong, Vic. M'Coy II., t. 19-5-7, R.J. 6-90.

* Since refered to C. Albida

91. Limopsis Belcheri. *Adams and Reeve.* (P.) Table Cape, Tas.; Geelong, Muddy Ck., Vic. M'Coy II., t. 19, 8-9.
92. Nucula Atkinsoni. *R. M. Johnston.* (P.) Table Cape, Tas.; Morgan, S.A.; Geelong, Vic. R. Ja. —. T. 4-3.
93. Nucula tumida. *Ten. Woods.* (P.) Table Cape, Tas.; Muddy Ck., Geelong; Schnapper Pt., Vic.; Morgan, S.A.
94. Nucula fenestralis. *Tate.* (P.) Table Cape, Tas. T. 4-4.
95. Leda Huttoni. *Ten. Woods.* (P.) Table Cape, Tas.; Muddy Ck., Vic.; Adelaide, Aldinga, S.A. Woods, Proc. Linn. Soc. N.S.W., viii., p. 239, 1878. T. 6-4.
96. Leda praelonga. *Tate.* (P.) Table Cape, Tas.; Muddy Creek, Vic. T. 12-4.
97. Leda crebrecostata. *Ten. Woods.* (P.) Table Cape, Tas. (Nuculana.) T W. 60, R.Jb. 90, T. 5-5.
98. Lucina planatella. *Tate.* (P.) Table Cape, Tas. Proc. Roy. Soc. Tas., 1884, p. 229.
99. Myodora æquilateralis. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
100. Myodora Australis. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
101. Mytilicardia platycostata. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
102. Panopæa Agnewi. *Ten. Woods.* (P.) (Lyonsia.) Table Cape, Tas. R.E. 155, T.W. Proc. Roy. Soc. Tas., 1875, p. 25. R.J. 6-90.
103. Placunanomia sella. *Tate.* (P.) Table Cape, Tas.; Blanchetown, Nine-mile Camp, S.A. T. 4-1.
104. Pecten Foulcheri. *Ten. Woods.* (P.) Table Cape, Tas.; Mt. Gambier, Murray Cliffs, S.A.; Muddy Ck., Vic. T. 3-14.
105. Pecten polymorphoides. *Zittel.* (P.) Table Cape, Tas.? Morgan, Blanchetown, Manum, S.A.; Muddy Ck., Vic.; Oamaru series, New Zealand. T. 8-2.
106. Pecten lucens. *Tate.* (P.) Table Cape, Tas.; Aldinga, Murray Cliffs, S.A. T. p. 22.
107. Pecten Zitteli. *Hutton.* (P.) (*Amusium Atkinsoni*, Johnston.) Table Cape, Tas.; Adelaide, Aldinga, S.A.; Muddy Ck., Vic. T. 7-3, R.Ja.
108. Pectunculus cainozoicus. *Ten. Woods.* (P.) Table Cape, Tas.; Adelaide, S.A.; Muddy Ck., Vic. T.W. (Cucullea) iii., R.J. 6-90, T. 10-8.
109. Pectunculus M'Coyii. *R. M. Johnston.* (P.) Table Cape, Tas.; Cape Schanck, Muddy Ck., Schnapper Point, Vic. Johnston, Proc. Roy. Soc. Tas., 1884, p. 199, T. p. 44.
110. Psammobia æqualis. *Tate.* (P.) Table Cape, Tas. (Tate.)
111. „ Hamiltonensis. *Ten. Woods.* (P.) Table Cape, Tas. (Tate.)
112. Solecurtus Legrandi. *Ten. Woods.* (P.) Table Cape, Tas. Woods, Proc. Roy. Soc. Tas., 1875, p. 17-25, fig. 14. R.J. 6-90, R.E. 157.
113. Spondylus gæderopoides. *M'Coy.* (P.) Table Cape, Tas.; Bird Rock, Schnapper Pt., Baggy Creek, Vic. R.E. 157, M'Coy V., t. 45, figs. 1 and 3.
114. Tellina cainozoica. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 61, R.J. 6-90, R.E. 157.

115. Trigonia semiundulata. *M'Coy.* (P.) Table Cape, Tas.; Bird Rock, Moorabool, Vic. R.E. 157.
116. Unio Johnstoni. *Etheridge, Jun.* (P.) Tamar, Launceston, Tas. Etheridge, Proc. Roy. Soc. Tas., 1880, p. 23, figs. 1-2.
117. Vola laticostata. *J. E. Gray.* (P.) Table Cape, Tas. (?) R.E. 159.
118. Zonatiopsis angustata. *Tate.* (P.) Table Cape, Tas.

Gasteropoda.

119. Helix Geilstonensis. *R. M. Johnston.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1879, p. 89.
120. Helix Huxleyana. *R. M. Johnston.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1879, p. 89.
121. Helix Sinclairoides. *R. M. Johnston.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1879, p. 89. *(H. Sinclairi.)*
122. Helix Simsoniana. *R. M. Johnston.* (P.) Kent Island. Proc. Roy. Soc. Tas., p. 24, figs. a. b. c., 1880.
123. Helix Tasmaniensis. *G. B. Sowerby.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1879, p. 88; Strzelecki, N.S.W. V.D.L. 1845, p. 298, t. 19, f. 6.
124. Vitrina Barnardii. *R. M. Johnston.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1884, p. 219.
124a. Bulimus Gunnii. *Sowerby.* (P.) Geilston, Tas. Proc. Roy. Soc. Tas., 1884, p. 219.
125. Terebra simplex. *Ten. Woods.* (P.) Table Cape, Tas.; Muddy Ck., Vic. Woods, Proc. Roy. Soc. Tas., 1875, p. 21, fig. 1.
126. Terebra additoides. *Ten. Woods.* (P.) Table Cape, Tas.; Morgan, S.A. T.W. 95.
127. Pleurotoma Johnstonii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 53. R.J. 6-90.
128. Pleurotoma paracantha. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 53, R.J. 6-90.
129. Pleurotoma pullulascens. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 52, R.J. 6-90.
130. Pleurotoma sandleroides. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 52 (Mangelia), R.J. 6-90.
131. Daphnella columbelloides. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 53, R.J. 6-90.
132. Daphnella gracillima. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 54, R.J. 6-90.
133. Daphnella tenuisculpta. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 54, R.J. 6-90.
134. Mangelia gracililirata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 54, R.J. 6-90.
135. Cancellaria Etheridgei. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
136. Murex Eyeri. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 41, R.J. 6-90.
137. Murex Legrandi. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
138. Murex minutus. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
139. Typhis M'Coyi. *Ten. Woods.* (P.) Table Cape, Tas.; Muddy Ck., Vic. R.E. 170, T.W. 1875, p. 22, R.J. 6-90.

140. Fusus gracillimus. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 22, R.J. 6-90, R.E. 164.
141. Fusus Johnstonii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 42, R.J. 6-90, R.E. 164.
142. Fusus Meredithii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, fig. 6, R.J. 6-90, R.E. 164.
143. Fusus pagodoides. *M'Coy.* (P.) Table Cape, Tas.; Schnapper Pt., Vic. R.E. 164.
144. Fusus Tateana. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 42, R.J. 6-90, R.E. 164.
145. Fusus vitreoides. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
146. Fusus transenna. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 42, R.J. 6-90, R.E. 164.
147. Fusus Roblini. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 22, fig. 1, R.E. 164.
148. Cominella cancellata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 55, R.J. 6-90, R.E 160.
149. Cominella lyræcostata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 56, R.J. 6-90, R.E. 160.
150. Ricinula purpuroides. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
151. Ricinula lactea. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
152. Buccinum fragile. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 55, R.J. 6-90, R.E. 159.
153. Thala marginata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 56, R.J. 6-90, R.E. 167.
154. Mitra anticoronata. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
155. Columbella Oxleyi. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 58, R.J. 6-90, R.E. 160.
156. Columbella cainozoica. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 59, R.J. 6-90, R.E. 160.
157. Voluta Agnewi. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
158. Voluta Allporti. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
159. Voluta M'Coyi. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 43, R.J. 6-90, R.E. 170.
160. Voluta lirata. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
161. Voluta pellita. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
162. Voluta Stephensi. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
163. Voluta stolida. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
164. Voluta Tateana. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
165. „ anticingulata. *M'Coy.* (P.) Table Cape, Tas.; Bird Rock, Schnapper Pt., Vic. M'Coy i., t. 6. —, f. 24, R.E. 170, R.J. 6-90.
166. Voluta antiscalaris. *M'Coy.* (P.) Table Cape, Tas.; Mt. Martha, Fyan's Ford, Vic. M'Coy i., p. 26, R.E. 170.

167. Voluta Hannafordi. *M'Coy.* (P.) Table Cape, Tas.; Mt. Martha, Fyan's Ford, Muddy Ck, Port Fairy, Vic. M'Coy iv., p. 23, R.J. 6-90, R.E. 170.
168. Voluta strophodon. *M'Coy.* (P.) Table Cape, Tas.; Schnapper Pt., Vic. M'Coy iv., p. 25, R.J. 6-90, R.E. 170.
169. Voluta macroptera. *M'Coy.* (P.) Table Cape, Tas.; Bird Rock, Vic. M'Coy i., p, 29, R.J. 6-90, R E. 170.
170. Voluta Weldii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 24, R.J. 6-90, R.E. 170.
171. Marginella Wentworthii. *Ten. Woods.* (P.) Table Cape, Tas.; Aldinga, S.A.; Muddy Ck., Vic. T.W. 57, R.J. 6-90, R.E. 165. (Tate.)
172. Marginella strombiformis. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 57, R.J. 6-90, R.E. 165.
173. Erato octoplicata. *Ten. Woods.* (P.) (Marginella.) Table Cape, Tas. T.W. 57, R.J. 6-90, R.E. 165. (Tate.)
174. Tritonium Abboti. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 24, R.J. 6-90, R.E. 168.
175. Tritonium minimum. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 55, R.J. 6-90, R.E. 168.
176. Tritonium Tasmanicus. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
177. Cassis sufflatus. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 41, R.J. 6-90, R.E. 160.
178. Cassidaria reticulospira. *Ten. Woods.* (P.) Table Cape, Tas.; Schnapper Pt., Vic. T.W. 1875, p. 17, R.J. 6-90, R.E. 160.
179. Turbonilla liræcostata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 49, R.J. 6-90, R.E. 169.
180. Turbonilla pagoda. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 49, R.J. 690, R.E. 169.
181. Odostomia liræcostata. *R. M. Johnston.* (P.) Table Cape, Tas. R.J., Proc. Roy. Soc. Tas., 1884, p. 223.
182. Leiostraca Johnstoniana. *Tate.* (P.) (*Eulimella subulata*, Woods.) Table Cape, Tas. Tate. Proc. Roy. Soc. Tas., 1884, p. 210, p. 227.
183. Cerithiopsis Johnstoni. *Ten. Woods.* (MS.) (P.) Table Cape, Tas. R.J. 6-90.
184. Rissoa Stevensiana. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 48, R.J. 1690, R.E. 167.
185. Rissoa dubia. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
186. Rissoina Johnstoni. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 49, R.J. 6-90, R.E. 167.
187. Rissoina Tateana. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 62, R.J. 6-90, R.E. 167.
188. Rissoina varicifera. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 49, R.J. 6-90, R.E. 167.
189. Torcula Murrayana. *Tate.* (P.) Table Cape, Tas.; Muddy Ck., Corio Bay, Schnapper Pt., Vic.; Murray Cliffs, S.A. Tate. Proc. Roy. Soc. Tas., 1884, p. 227.
190. Turritella Sturtii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 47, R.J. 6-90, R.E. 169.
191. Turritella Tasmanica. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 47, R.J. 6-90, R.E. 169.

192. Turritella Warbutonii. *Ten. Woods.* (P.) Table Cape, Tas.; Murray Cliffs, Mt. Gambier, S.A. T.W. 36, R.J. 6-90, R.E. 169.
193. Turritella sp. ind. (P.) Flinders Island. Johnston, Proc. Roy. Soc. Tas., 1876, p. 36.
194. Turritella tristira. *Tate.* (P.) Table Cape, Tas. Tate, Proc. Roy. Soc. Tas., 1884, p. 227.
195. Tenagodus occlusus. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 48, R.J. 6-90, R.E. 167.
196. Vermetus conohelix. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 48, R.J. 6-90, R.E. 170.
197. Potamides pyramidale. *Tate.* (P.) Table Cape, Tas. Tate, Proc. Roy. Soc. Tas., 1884, p. 226.
198. Potamides semicostatum. *Tate.* (P.) Table Cape, Tas. Tate, Proc. Roy. Soc. Tas., 1884, p. 226.
199. Trochita calyptræformis. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 34, R.J. 6-90, R.E. 169.
200. Crepidula Hainsworthii. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja., Proc. Roy. Soc. Tas., 1884, p. 232, figs. —
201. Crepidula umbilicata. *R. M. Johnston.* (P.) Table Cape, Tas. R.J., Proc. Roy. Soc. Tas., 1884, p. 233, figs. a. b. c.
202. Turbo, Wynyardensis. *R. M. Johnston.* (M.S.) (P.) Table Cape, Tas.
203. Turbo Etheridgei. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 46, R.J. 6-90, R.E. 169.
204. Calcar ornatissimum. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 44, R.J. 6-90, R.E. 160.
205. Calcar Flindersi. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 43, R.J. 6-90, R.E. 160.
206. Euchelus Woodsii. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
207. Thalotia alternata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 45, R.J. 6-90, R.E. 168.
208. Zizyphinus atomus. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
209. Zizyphinus Tasmanicus. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
210. Zizyphinus Bloxlandii. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 44, R.J. 6-90, R.E. 171.
211. Trochus Josephi. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 45, R.J. 6-90, R.E. 169.
212. Torinia gibbuloides. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 45, R.J. 6-90, R.E. 168.
213. Gibbula æquisulcata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 46, R.J. 6-90, R.E. 164.
214. Gibbula Clarkei. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 62, R.J. 6-90, R.E. 164.
215. Gibbula crassigranosa. *Ten. Woods.* (P.) Table Cape. Tas. T.W. 46, R.J. 6-90, R.E. 164.
216. Margarita Keckwickii. *Ten. Woods* (P.) Table Cape, Tas. T.W. 45, R.J. 6-90, R.E. 165.
217. Liotia lamellosa. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 44, R.J. 6-90, R.E. 165.
218. Liotia Roblini. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.

219. Delphinula (?) tetragonostoma. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 44, R.J. 6-90, R.E. 162.
220. Adeorbis lævis. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
221. Trivia avellanoides. *M'Coy.* (P.) Table Cape, Tas.; Schnapper Pt., Muddy Ck., Vic. M'Coy iii., p. 36. R.J. 6-90, R.E. 16.
222. Cypræa Archeri. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 23, R.J. 6-90, R.E. 161.
223. Cypræa eximia. *G. B. Sowerby.* (P.) Table Cape (?), Franklin Village, Tas.; Schnapper Pt., Vic. Strzelecki's Phys. Descr. N.S.W., V.D.L., 1845, p. 296, t. 19 f 1-3, R.J. 6-90, R.E. 161.
224. Cypræa platypyga. *M'Coy.* (P.) Table Cape, Tas.; Schnapper Pt., Vic. M'Coy iii., p. 39, R.J. 6-90, R.E. 162.
225. Cypræa platyrhyncha. *M'Coy.* (P.) Table Cape, Tas.; Bird Rock, Vic. M'Coy iii., p. 40. R.J. 6-90, R.E. 162.
226. Scalaria sp. ind. (P.) Table Cape, Tas.
227. Crossea labiata. *Ten. Woods.* (P.) Table Cape, Tas.; S.A. ? (Tate.) It is doubtful whether this form is identical with the living form in Tas.
228. Natica ovata. *Hutton.* (P.) Table Cape, Tas. T.W. 1875, p. 17.
229. Natica polita. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 1875, p. 17, R.J. 6-90, R.E. 166.
230. Natica Wintlei. *Ten. Woods.* (P.) Table Cape, Tas.; Muddy Ck., Vic. T.W. 1875, p. 23, R.J. 6-90, R.E. 166.
231. Natica vixumbilicata. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 59, R.J. 6-90, R.E. 166.
232. Pyramidella sulcata. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
233. Pyramidella polita. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
234. Pyramidella Roberti. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 62, R.J. 6-90, R.E. 166.
235. Fissurellidæ malleata. *Tate.* (P.) Table Cape, Tas.; Murray Cliffs, S.A. Tate, Proc. Roy. Soc. Tas., 1884, p. 208.
236. Emarginula transenna. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 51, R.J. 6-90, R.E. 163.
237. Pileopsis navicelloides. *R. M. Johnston.* (P.) Table Cape, Tas. R.Ja.
238. Cylichna Woodsii. *Tate.* (P.) Table Cape, Flinders Island, Tas. Tate. Proc. Roy. Soc. Tas, 1884, p. 208. (*C. arachis*, Woods.)
239. Actæon scrobiculatus. *Ten. Woods.* (P.) Table Cape, Tas. T.W. 50, R.J. 6-90, R.E. 159.
240. Ancillaria mucronata. *G. B. Sowerby.* (P.) Table Cape, Tas. T.W. 34, R.J. 6-90, R.E. 159.
241. Dentaluim Kickxii. *Nyst.* (P.) Table Cape, Tas. T.W. 1875, p. 15, R.J. 6-90, R.E. 162.
242. Dentalium lacteum. *Deshayes.* (P.) Table Cape, Tas. T.W. 1875, p. 17, R.J. 6-90, R.E. 163.

Cephalopoda.

243. Aturia ziczac. *J. Sowerby.* (P.) Table Cape, Tas. (Bell.)

Pisces.

244. Carcharodon augustidens. *Agassiz.* (P.) Table Cape, Tas.; Bird Rock, Vic. M'Coy ii., p. 8, R.J. 6-90, R.E. 171.
245. Lamna elegans. *Agassiz* (P.) Table Cape, Tas.; Bird Rock, Vic. R.J. 6-90, R.E. 172.
245a. Oxyrhina trigonodon. *Agassiz.* Table Cape.

Mammalia.

246. Hypsiprymnus sp. ind. (P.) One Tree Point, Hobart; Geilston, Tas. Johnston. Proc. Roy. Soc. Tas, 1881, p. 12. Teeth and leg bones.
247. Halmaturus sp. ind. (P.) Turritella Sandstone, Table Cape, Tas. Fine specimen in Tas. Mus., Hobart.
248. Phalascomys sp. ind. (P.) One Tree Point, Hobart. Johnston. Proc. Roy. Soc. Tas., 1881, p. 12. Teeth.

POST TERTIARY.

Gasteropoda.

1. Helix Diemenensis. *Cox.* (P.T.) Helicidæ Sandstone, Furneaux Group, Tas. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.
2. Helix Furneauxensis. *Petterd.* (P.T.) Helicidæ Sandstone, Furneaux Group, Tas. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.
3. Helix pictilis. *Tate.* (P.T.) Helicidae Sandstone, Furneaux Group, Tas.; Cape Northumberland, S.A. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.
4. Helix Stanleyensis. *Petterd.* (P.T.) Helicidae Sandstone, Furneaux Group, Tas. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.
5. Vitrina Verreauxi. *Pfr.* (P.T.) Helicidae Sandstone, Furneax Group, Tas. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.
6. Succinea Australis. *Fer.* (P.T.) Helicidae Sandstone, Furneaux Group, Tas. Johnston, Proc. Roy. Soc. Tas., 1879, p. 49.

6a. Bithynella nitida. *R. M. Johnston.* Helicidæ Sandstone, Thunder and Lightning Bay, Barren Island.

Marsupialia.

7. Halmaturus Bennettii. *Waterhouse.*
8. „ Billardieri. *Desmarest.*
9. Bettongia cuniculus. *Ogilby.*
10. Potorous murinus. *(White's Journal.)*
11. Phascolomys wombat. *Peron-et-Les.*
12. Phalangista vulpina. *Shaw*
13. „ Cookii. *Desmarest.*

Rodentia.

14. Mus castaneus. *Higgins and Petterd.*
15. „ pachyurus. „ „

} Higgins and Petterd, Proc. Roy. Soc. Tas., 1883, p. 191.*

*Bones discovered in one of the chambers of the Chudleigh Caves, Tas., by Mr. Fred. Henry.

In one of the innermost chambers the remains were found lying on the projecting shelves of rock, to which they were agglutinated by thick stalactitic incrustation. Still larger quantities are found in the crevices of the rock, whilst the earthy and stalagmitic floor yields an abundance of the species named, which have been carefully compared with recent specimens by Messrs. Higgins and Petterd.

16. Phalangista fuliginosa. *Ogilby.* Found by Mr. Wintle at Glenorchy Cave, Tas., together with No. 7. (Krefft.) R.E. 182-187.

EXPLANATION OF ABBREVIATIONS USED IN CATALOGUE.

R.E.—Refers to Catalogue of Australian Fossils, by Robt. Etheridge, jun., F.G.S. (London, 1878.) The number refers to the page.

T.W.—Refers to descriptions of certain species of fossils from Table Cape, Tasmania, by the Rev. Tenison-Woods, F.L.S., etc. (*Proceedings of Roy. Soc. Tas.*, July, 1886.) The number refers to page.

M'C.—Refers to descriptions or figures of fossils contained in certain of the "decades" of the geol. survey of Victoria, by Prof. M'Coy, F.G.S., etc. Numbers refer to vol. and page respectively.

T.—Refers to description and figures of fossil shells contained in "Lamellibranchs of the older tertiary" (*Trans. Roy. Soc. of Adelaide*, 1885), by Prof. R. Tate, F.G.S., etc. The numbers refer to plates and figures.

R.T.—Refers to descriptions and figures of fossil brachiopods contained in "Palliobranchs of Australia," by Prof. R. Tate, F.G.S. (*Trans. Phil. Soc. Adelaide*, 1880.) The numbers refer to plates and figures.

R.J.—Refers (*a*) to the author's descriptions of fossils contained in "Third Contribution to the Natural History of the Marine Beds at Table Cape. (*Proc. Roy. Soc. Tas.*, April, 1879.) (*b* or 6.) Ditto Catalogue showing Distribution of Tertiary Fossils. (*Proc. Roy. Soc. Tas.*, July, 1878.) The following number refers to page. (*c.*) (*Proc. Roy. Soc. Tas.*, 1884, p. 223.)

E.—Refers to Ettingshausen's *Beiträge zur Kentniss der Tertiärflora Australiens.* Wien, 1883.

J.—Refers to Johnston's notes, Estuary of the Derwent during the Tertiary Period. (*Proc. Roy. Soc. Tas.*, 1881.) (April.)

(P.)—Indicates the "Palæogene" era; equivalent in Tasmania to Eocene and Miocene taken together.

ANTARCTIC EXPLORATION.

(By Chas. P. Sprent, Deputy-Surveyor-General.)

During the last three years the subject of Antarctic Exploration has frequently been brought forward and discussed by the Scientific Societies of Europe, America, and Australia, and a general desire has been expressed to see a renewal of scientific investigations in those almost unknown regions. The North Polar regions have been so far explored that no new discoveries of any importance are to be looked for in that quarter; the theory of an open Polar Sea has been annihilated by the discoveries of Sir George Nares and Lieut. Greeley, and it is now clearly understood that the North Pole is surrounded by a frozen sea of ancient ice, the Palaocrystic Sea, over whose rugged surface travelling is so painfully slow that all hope of reaching the Pole by ordinary means of progression has been abandoned. For forty-three years no scientific expedition has visited the Antarctic Seas, and as during that period immense advances have been made in all branches of scientific enquiry, it is only natural that, with the hope of acquiring new facts, as well as of verifying recorded facts, the attention of the scientific world is being directed to the South Polar regions, where so little has been done in the way of exploration that, with the exception of a few detached pieces of coast-line, nothing whatever is known of an area of the globe fully as large as the Continent of Europe. Baron von Mueller, the President of the Victorian Branch of the Geographical Society of Australasia, referred to the subject in his annual address in 1884, and last year he dealt with it more fully. His remarks appear to have attracted some attention, for the Geographical Section of the British Association, under the presidency of Lord Abedare, have now taken up the subject and given it their powerful support. In September of last year the Association appointed a Committee, consisting of Sir Leopold McClintock, Sir George Nares, Sir Joseph Hooker, Dr. Carpenter, Mr. Clements Markham, and others, to bring up information.

Admiral Sir Erasmus Ommanney, who was appointed Secretary, read a paper before the Association setting forth the history of previous explorations, the results achieved, and the problems to be solved by future exploration. Unfortunately, no copy of this report is to be found in Hobart, but I notice that, as the project meets with much support both in England and on the Continent, it is probable that an Expedition will shortly be organised. I notice also that it is likely the British Association will visit Sydney next year; if

so, the project will probably be brought forward at that meeting, and some definite plan arranged.

It has been suggested that before any costly large Expedition is despatched, it would be advisable to send out a pioneer vessel to examine certain unknown parts, to select suitable places for winter quarters, and make preliminary observations. The Geographical Society of Australasia and the Royal Society of Victoria are anxious that this preliminary Expedition should be undertaken by Australia, and have invited the co-operation of the various Governments and learned Societies of these colonies, hence the communication which we have arranged to discuss this evening. There are about half a dozen members of the Geographical Society of Australasia residing in Tasmania, and as one of them I have been requested on behalf of that Society to place the subject before you. I have, therefore, compiled some information from the best available authorities, in the hope that the Fellows of this Society, and the public of Tasmania generally, may be induced to take an interest in the matter, and assist in securing the proper representation of Australia in any new exploration of these Southern Seas. And I appeal to the sympathy of this Society all the more confidently because there are some of you—Mr. Barnard, our chairman, is one—who, as members of the Tasmanian Society, the parent of our Society, enjoyed the personal friendship of those heroes of Polar discovery, Sir John Franklin, Sir James Ross, and Captain Crozier, and heard them narrate their now world-renowned adventures.

In compiling this paper I have availed myself of Sir James Ross's Voyages, Wilkes's Voyages, Dr. Neumayer's papers in the 7th Volume of Nature, papers by Sir Wyvill Thompson and Mr. Moseley, of the Challenger staff, addresses delivered in Melbourne by Baron von Mueller, Mr. G. S. Griffiths, Mr. Macdonald, and others, as well as the articles upon the subject in the 19th volume of the Encyclopædia Brittanica. With this acknowledgment, I plead guilty to having frequently adopted the very language of my authorities.

To understand what has already been done, a brief history of Antarctic discovery is necessary; and before entering upon that narrative it may be mentioned that as far back as the 16th century geographers argued the existence of a large southern continent, necessary in their opinion to balance the weight of land in the Northern Hemisphere; and just as there are to be found vague accounts of prehistoric discoveries in the Arctic regions, so we may discover similar accounts of supposed discoveries in Southern Seas.

In January, 1600, one Dirk Gerritz, a Dutchman, on a voyage from the East Indies, falling in with tempestuous

weather off Cape Horn, was driven so far south that he reached some ice-bound islands, where he saw immense numbers of whales and seals. His story was not believed at the time, but it is now generally conceded that he actually did cross the Antarctic Circle.

When New Holland was first discovered it was supposed to form part of the Antarctic Continent, and was so delineated upon the maps until 1642, when Tasman proved it to be an island. The area of the supposed continent having been thus reduced, it was delineated as extending as far north as Kerguelen. In 1773, Cook, sailing on a westerly line, passed far to the south of Kerguelen; and in 1775 he penetrated to 71° S., exploring between 175° and 98° W. longitude. Cook made a complete circuit of the Southern Ocean, several times crossing the Antarctic Circle, thus proving that if any continent existed it must be looked for inside the circle. It is worthy of note, as exemplifying the difference in seasons, that Cook reached his highest point, his "ne plus ultra," as he called it, without entering the ice. We shall see that subsequent explorers passed through hundreds of miles of ice before reaching the same latitude.

In the beginning of the 18th century American whale and seal fishermen, operating in the vicinity of the Falkland Islands, sailing south, re-discovered the islands reported by Gerritz.

In 1819 an expedition was sent out by Russia, under Bellinghausen, with the avowed intention of reaching the South Pole. They sailed south on the meridian of Greenwich, and reached lat. 69° 25′ S.; subsequently they reached 69° 31′, and then gave up the attempt, having failed to reach as high a latitude as Cook. They discovered Peter the First Island and Alexander Land.

In 1823 Captain Weddell, of Leith, with two small vessels —one of 160 tons, the other of 60 tons—sailed from the South Shetlands on a whaling voyage, and, finding the sea open, penetrated to 74° 15′—a remarkable performance for such small vessels, and one that has never since been equalled in that portion of the Southern Seas. Weddell, besides being a daring navigator, seems to have been a skilful fisherman, for during the few seasons he was in South Georgia he obtained 20,000 tons of sea elephant oil and several cargoes of fur sealskins, which he afterwards took to China and sold at a dollar a skin. Weddell's performance eclipsed Cook's, and is second only to Ross's.

In 1830 the Messrs. Enderby, of London, despatched Captain Biscoe on a whaling voyage to the Southern Seas, when he discovered Enderby's Land, Adelaide Island, and Graham's Land. In 1839 the Enderbys sent out Captain Balleny with

the brig Eliza Scott and the cutter Sabrina. This voyage led to the discovery of Balleny Islands and Sabrina Land. These discoveries did not attract much notice at the time, they came more prominently before the public a few years later, when Wilkes and D'Urville disputed as to the honor of having discovered the long sought for Antarctic Continent. Undoubtedly these whaling captains are entitled to whatever honor there is to be gained from first discoveries in that quarter.

From 1839 to 1843 the exploration of the Antarctic was vigorously prosecuted by American, French, and English naval expeditions as well as by a few American and English whalers. The French Expedition, commanded by Dumont D'Urville, took up the exploration of the region round the South Shetland Islands. They discovered Joinville Island and Louis Phillippe Land, although Weddell seems to have been aware of their existence. In 1840 D'Urville visited Hobart with the corvettes Astrolabe and Zelée; he refitted his ships here, and then sailed south again; on this occasion he discovered Adelie Land and Clarie Land. It would appear that French seamen are not physically fit for prolonged exertion in high latitudes, for D'Urville's crews suffered so severely from scurvy and sickness that he was compelled to shorten his cruise.

The American Expedition was under the command of Captain Charles Wilkes, it consisted of two sloops, one brig, and a schooner; the Antarctic cruise was merely a short portion of a programme extending over several years' sailing.

They made their first acquaintance with Antarctic work in the vicinity of the South Shetlands, but they did not make any new discoveries of importance, and failed to reach Weddell's latitude. They made their way to Sydney, where they refitted, and then sailed south on the meridian of 170°. On the 11th January, 1840, they found their further progress south cut off by a perpendicular barrier of ice; they were of the opinion that they could see land in the distance over and beyond the ice. Wilkes claims that he discovered the Antarctic Continent on the 16th January, in long. 157° 46′. Whether he did or not is hard to say; he appears to have been rather too sanguine and too ready to accept appearances. He obtained no bottom at 850 fathoms, so that one is inclined to think that he was wrong here, as he was proved to be wrong in other places. On the 20th January, in longitude 140deg. 2min. 31sec. E. and lat. 66deg. 45min. S., they undoubtedly did discover land. Wilkes says—"We approached within half a mile of the dark volcanic rocks which appeared on both sides of us, and saw the land gradually rising beyond the ice to the height of 3,000 feet, and entirely covered with snow. It could be distinctly seen extending to

the east and west of our position fully sixty miles; and now, when all were convinced of its existence, I gave the land the name of the Antarctic Continent. Some of the officers pointed out the appearance of smoke, as if from a volcano, but I was of the opinion that this was nothing but the snow drifts caused by the heavy squalls."

They followed along the barrier ice as far as long. 100deg. E., having land in view all the way; but finding themselves unable to set foot on anything but ice, and being unable to get any further south, they rerurned to Sydney.

The English Expedition sailed in August, 1839, consisting of the Erebus, under Captain Ross, and the Terror, under Commander Crozier, both well-trained and experienced ice navigators. Ross gained his laurels under Parry, whose highest north was not eclipsed until Nares' Expedition in the Alert and Discovery. He was also remarkable in Arctic exploration as the discoverer of the North Magnetic Pole. After some unimportant explorations, Ross brought his ships to Hobart, where he established an Observatory, and left an officer to make systematic observations. Before leaving England Ross had given the Americans the benefit of his counsels in equipping their expedition, and had openly announced to the world where his own ships would operate, he was, therefore, not a little piqued on his arrival in Hobart to learn that D'Urville and Wilkes had both selected the same ground. Disdaining to follow anyone's tracks, Ross selected the meridian of 170°, intending to work to the eastward of that line, and on that meridian he crossed the Antarctic Circle on New Year's Day, 1841. As the Erebus and Terror had both been specially strengthened to encounter ice, their commanders sailed them right into the pack ice, battling their way for 200 miles through its broken fragments, until they emerged upon the open sea in lat. 69deg. 15min. S., and long. 176deg. 15min. W. On the 11th January land was discovered, and on the night of that date a landing was effected upon an island, where they planted the British flag, and drank the healths of the Queen and the Prince Consort. This place they called Possession Island; it and Franklin Island are the only two places in that part of the Antarctic where a landing has been effected. Wilkes, as we have seen, never landed at all, and D'Urville only succeeded in setting foot upon a small rock. Having the mainland in sight they followed the coast line for 10deg. of latitude, naming the country S. Victoria Land. On reaching 78deg. S. they discovered a volcano upwards of 12,000 feet high in active eruption; this they named Mt. Erebus, a quiescent peak close by being named Mt. Terror. They saw Mt. Erebus belching out fire and smoke, and the lava running down its

snow-clad peak. In latitude 78¼ they found their further progress south stopped by a barrier of ice, presenting a perpendicular cliff to the sea, from 150 to 200 feet high. After sailing along this barrier for some distance, they found the sea beginning to freeze, so they retraced their course along Victoria Land until Ross was able definitely to fix the position of the South Magnetic Pole; but owing to the impossibility of scaling the ice barrier and traversing the land, they did not attempt to reach the exact spot. Ross thus achieved the remarkable distinction of being the discoverer of both the magnetic poles of the earth; he had actually stood upon the spot of the North Magnetic Pole.

One incident of this trip led to much acrimonious discussion. Wilkes had presented Ross with a chart of his discoveries, showing a shore line backed with mountains extending from 97 to 107 E. long. Ross sailed right over the spot where Wilkes showed a mountain, and as the weather was perfectly clear at the time, Ross says he should have seen any high land within a radius of 70 miles. He hove his lead in 600 fathoms where a mountain had been reported. The Erebus and Terror returned to Hobart from this voyage.

On their second voyage they visited New Zealand and the islands to the south. They encountered the first icebergs in lat. 58deg. 36min., and entered the ice-pack in lat. 60deg. 50min. On this occasion they encountered much more pack ice than on their first voyage; and it is somewhat remarkable that whereas Cook reached his highest point without entering the ice, Ross and Crozier passed through 800 miles of it before reaching the same parallel. They reached 78deg. S. somewhat to the east of their former position; they traced the barrier along for some distance to the eastward, and although they saw appearances of land, they made no important discoveries. They retreated along the edge of the pack, and then bore away for the Falkland Islands, where they wintered.

In 1843 they explored the islands near the S. Shetlands, discovering new land in several places. They reached 71deg. 30min. S., beating Bellinghausen, but failing to equal Weddell, who reached 74deg. They found it impossible to make a way through the pack ice without running great risk of being frozen in; they therefore made their way up to the Cape of Good Hope, and then back to England.

This may be said to close the history of Antarctic discovery, for although the Challenger steamed south from Kerguelen, she only went as far as 66deg. 40min., where they searched for Wilkes' Termination Land without finding it; she sounded

in 1,300 fathoms of water within six miles of where it was stated to exist.

Having now sketched out the history of Antarctic discovery, we may proceed to notioe the results achieved, and from an examination of the facts recorded, endeavour to form some conclusion as to the physical geography of this interesting region. Glancing at the maps of the Arctic and Antarctic regions, the first thing that strikes us is that the physical features are exactly opposite. In the Northern Polar regions there is a large preponderance of land; in the South the land masses are small in comparison with the vast extent of ocean. In the North the land masses are so close to the great continents that men, animals, and plants have distributed themselves over all the habitable regions; in the south the patches of land known to exist are isolated from temperate regions by a wide belt of stormy sea, and except in the direction of South America there is no appproach to the other land divisions of the globe. To this circumstance we may ascribe the want of interest shown in Antarctic discovery. For some three hundred years the Arctic Seas were explored in the hope of finding a North-west Passage to China and India, and for many years expeditions were employed in searching for tidings of the fate of Franklin and his companions. The number of purely scientific expeditions was small indeed until within the last ten years.

It will be seen that outside of the Antarctic Circle the land consists of a few small islands, mere dots in the ocean. Inside the Antarctic Circle the land masses are so imperfectly known that we are unable to say whether there is a continent or merely a series of detached groups of islands. The balance of evidence is in favour of the supposition that the Antarctic lands are groups of islands connected together with a continuous ice sheet. The greater part of the land hitherto examined is comparatively low, rarely rising above 2,000 feet in altitude, including the ice cap, the exceptions to this rule being the great mountain chain extending from Balleny Island down Victoria Land to Mt. Erebus, including several peaks rising above 14,000 feet in elevation. Other mountain masses are to be found on Peter the Great Island, Adelaide Island, and Louis Phillipe Island.

With the exception of a few points swept bare by currents, all the land appears to be fringed with an ice barrier, varying from 70 to 200 feet in height. D'Urville, Wilkes, and Ross all agree in describing this barrier, none of them were able to scale it, consequently none of these explorers set foot upon the main land. Far away beyond the barrier, in the misty distance, vague forms of hills have been reported, but the appearances are so often deceptions that inexperienced

explorers are apt to be misled in the way Wilkes was. The barrier is so unlike anything that occurs in the Arctic regions and is so remarkable a feature in the Antarctic, that a few minutes may be devoted to explaining its formation. The late Sir Wyvill Thompson, in a lecture delivered by him at Glasgow, gives a very interesting account of the peculiarities of Antarctic ice, and to him I am largely indebted for what follows:—

Some idea of the formation of the barrier may be gathered from an examination of the icebergs found floating northwards, often as low as 42deg., in the track of vessels making the Australian voyage. All observers agree in describing these bergs as being fundamentally of a tabular form, composed of layers of ice in regular strata of varying degrees of density. It is true that as these bergs reach warmer waters their original forms become obscure, and they melt into all sorts of irregular shapes, but they always retain their original lines of stratification. They are entirely different to the Arctic bergs, which are always of irregular or fantastic shapes, and entirely devoid of stratification; this difference is to be ascribed to the different circumstances attending their formation and not to difference of weathering. As a general rule, the Arctic Coast line, except in winter, is bare or only fringed with broken ice. Deep indentations resembling those on the Norwegian Coast, are numerous, and invariably, at the head of these indentations, glaciers push their way into the sea. It is these glaciers or ice rivers that furnish the Arctic bergs. The general ice sheet is comparatively thin; on the coast of Greenland, as far north as Peterman Inlet, it is not more than 40 feet thick. The Antarctic bergs are masses broken off from the great barrier; they are often of immense size, several have been noticed over four miles long. The stratification is due to the fact that they are formed by successive layers of snow falling upon flat land. The water in front of the land being shallow, and the land itself presenting but a slight slope, the ice moves slowly forward, pushing its way into the sea until it reaches water so deep that the lower stratum of ice no longer rests upon the bottom; part of the mass then breaks off and floats away before the prevailing winds. Whilst this is going on the surface is constantly receiving fresh deposits of snow; these partially melt, and then freeze again into ice. When the bergs first float away their lines of stratification are parallel to the surface of the sea; as their bases melt their centres of gravity becoming changed, they roll over, exposing fresh surfaces, and tilting up the strata at various angles. Caves are worn into the perishing ice, and the superincumbent strata often bend, exhibiting those foldings and contortions we are

familiar with in stratified rocks. Sir Wyvil Thompson describes the bergs seen by him as being of a beautiful blue colour, gradually deepening in tint towards the base, and states that all were of the tabular form, and that they did not see one single berg whose appearance indicated that it had been formed by passing down a valley or over uneven ground, nor were any seen carrying rocks, stones, or gravel. As Antarctic bergs are often met with upwards of 150 feet high above the water line, and as from their specific gravity they must have at least eight times as much depth below water, it follows that they have a total thickness of at least 1,400 feet. The bergs are met with as low as 42deg. S., and the Hon. Audley Coote informs me that he has encountered several in about that latitude within a few hundred miles of the Tasmanian coast. Wilkes says that in the year 1832 bergs were so numerous about Cape Horn that vessels were compelled to return to Valparaiso. The largest berg measured was 210 feet above the water line.

The pack ice of the Antarctic seems to be much more broken than that of the Arctic. Ross says that they rarely saw a piece more than a quarter of a mile in circumference, whereas in the Arctic seas pieces four miles in diameter were met with, and at times the pack consolidated into "fields," covering the sea as far as could be seen from the ship. This difference is ascribed to the fact that the Antarctic seas are rougher than the Arctic.

In the Arctic regions the large extent of the land masses, and the influence of warm currents produced by the dispersion of the Gulf Stream exert an ameliorating influence upon the climate tending to break up the ice. In the south no such influences exist, and therefore the summer climate is colder than the northern climate in corresponding parallels. As to the winter climate we can only form conjectures, as no one has yet wintered within the Arctic circle. Maury, who had ample opportunities of forming opinions as to the climates of both regions, thinks that the mean temperature is higher in the south than in the north, and there is some evidence to support his theory. A self-registering thermometer was left on the South Shetland in latitude 63deg., and after remaining there for several years it was examined and found to register a minimum of 37deg. F. below freezing point; the mean winter temperature of several localities in the same latitude north is 68deg. F. below freezing. It would appear that various points in the outline of the ice are influenced by warm currents, for although so much of the great equatorial current as is deflected south is, to a great extent, swallowed up in the vast expanse of ocean, yet some portions escape, and their influence can be traced.

In the summer time the ice pack is in a broken up condition, and there are deep notches in its general outline, apparently due to the currents which flow down the American Coast and the Coast of New Zealand; it is in these directions that explorers have reached their highest latitudes. How far the Antarctic climate may be influenced by volcanic heat we are unable to say. Rain is not frequent, but snow falls on an average every other day.

Very little is known of the geology of the Antarctic regions, only a few outlying islands have been examined, and these are all volcanic. Specimens of rocks have been obtained by dredging the sea bottom, a few have been gathered from floating ice, and some from the stomachs of seals and penguins; Dr. McCormack, of the Erebus, says the penguins were his best collectors, some of them having as much as 10lbs. of stones in their stomachs. It has been already mentioned that no icebergs are met with carrying stones on their upper surface, but it is evident that the ice sheet moving slowly over the surface of the land must detach rocks with its lower stratum, and accumulate mud from the grinding of the surface over which it passes. These materials are dropped as the bergs meet in warmer waters, hence it is found that the sea bottom is strewn with the remains of the Antarctic land. All the specimens procured from the sea bottom in the vicinity of S. Victoria Land and the South Shetlands are precisely such as would be furnished by the West Coast of Tasmania, they comprise greenstone, basalt, granite, mica slate, chlorite slate, hornblende slate, and clay slate. One cannot help speculating whether any valuable minerals exist under that great ice sheet, a "rush" to the Frozen South would be something novel, although a precedent can be found; as far back as Queen Elizabeth's time a number of English gentlemen sailed under Martin Frobisher to look for gold in the Frozen North,—it is needless to say they were disappointed. Dr. McCormack says that the Islands south of Cape Horn are all volcanic. The only specimens procured were basalt, greenstone, granite, vesicular lava, scoriæ, and pumice, the greenstone is frequently columnar, indeed some of the capes are exactly similar to Cape Pillar. It is somewhat remarkable that no specimens of recent stratified rocks have been obtained, nor can I hear of any fossils having been found. Although volcanic rocks are largely developed in the Arctic regions we find there a considerable thickness of Palæozoic rocks and Tertiary deposits, the former containing coal seams and the latter extensive leaf deposits. We are accustomed to associate coal plants with a moist steamy atmosphere, so that at one time the climate of Greenland must have been sub-tropical. The Tertiary Leaf Beds contain abundant remains of the oak, syca-

more, poplar, elm, magnolia, sequoia sassafras viburnum, and other trees of temperate zones. We are here confronted with one of the most interesting problems of geology. How did those plants contrive to flourish in a region where no trees can now exist, and where there is for many months a total absence of sunlight. Is it possible that the ice which now covers the two poles is a mere accidental occurrence in time. It would seem that at one time the North Pole at all events enjoyed light, sunshine, and warmth. We know that the ice which now is confined to the Polar regions at one time extended as far south as the middle of France, and that there came a warm interval when the lion, rhinoceros, elephant, crocodile, and other tropical animals spread themselves over Europe as far north as Scotland, and that the cold returning these animals were destroyed or driven south again. I am well aware that certain physicists explain these matters some by referring to the precession of the equinoxes and others by supposing a change in the axis of rotation; but the changes due to the former cause will not account for the presence of coal plants in Northern Greenland, and the most eminent mathematicians reject the possibility of the latter. Sir William Thomson says that the axis of the earth cannot have been changed without "such enormous transposition of matter on the earth's surface or else such distortions of the whole solid mass as would present far greater difficulties of another kind than those with which we have had to deal." Whilst all these changes were going on in the Northern Hemisphere what was the state of things in the Southern? Is there any evidence of a Glacial Period in Australia? I observe that this question is being discussed in our contemporary Societies. Some light may be thrown on this problem when we become better acquainted with the geology of the Antarctic.

Again what is the present state of the volcanic forces of the Antarctic? Ross saw Mt. Erebus in active eruption, some of the officers of the Terror thought they saw smoke issuing from the lofty peaks of Louis Phillipe Island, some of the American officers were of opinion that they saw volcanoes, and one American whaling captain reported that on visiting Deception Island, one of the S. Shetlands, he found 13 craters in active eruption. An active crater is supposed to exist on Kerguelen, and we have had recent experience of the New Zealand volcanoes. Remembering that Iceland is the theatre of vast volcanic forces and that Jan Mayen is still active within the Arctic Circle some theorists have been led to suppose that the earth's crust thins out at the Poles.

Geologists will look forward with great interest to the prospect of further exploration in the Antarctic.

It is not my intention to describe the Flora and Fauna of

the South Polar regions. I confine myself to dealing with some points arising from a comparison of the life found in those scattered lands : Mr. Griffiths, of Melbourne, gives some interesting information, based on the observations of Darwin, Wallace, Hutton, Sir Joseph Hooker, and others. Thus 44 per cent. of the New Zealand flora is of Antarctic origin ; whilst the Auckland, Campbell, and Macquarie Islands all support Antarctic plants, some of which have never reached New Zealand. The flora and fauna of Kergulen, the Crozets, and Marion Island are almost identical. Tristan d'Acunha has 58 species of marine molluscs, of which 13 are also fonnd in S. America, 6 or 7 in New Zealand, and 4 in South Africa. Temperate S. America has 74 genera of plants in common with New Zealand and 11 of its species are identical.

Dr. Hooker, writing of the botany of Tierra del Fuego, says:—"The Fuegian flora possesses some other points of interest when viewed in comparison with that of the Antarctic Islands lying to the south of New Zealand, also with that of the Falkland Islands, S. Georgia, Tristan d'Acunha, and Kerguelen Island. All these countries, though the latter is distant some 5,000 miles, seem to have borrowed many plants from this, the great botanical centre of the Antarctic Ocean. And it is a still more surprising fact that the vegetation of Fuegia includes a considerable number of English plants, although 106 degrees of ocean roll between, and some of the species in question inhabit no intermediate latitudes." The inference drawn from these remarkable facts is that at one time a large extent of land existed in the Southern Ocean, that it has subsided beneath the ocean, leaving only isolated peaks as evidence of its former existence. The investigations of the Challenger staff show that Kerguelen, its adjacent islands, the Crozets, Marion, and other islands stand on one common submerged plateau rising to within 1,500 fathoms of the surface. These considerations, in view of the recent discoveries of leaf remains in our Tertiary Beds of species related to oaks, laurels, elms, &c., might furnish our friend Mr. Johnston with material for a paper on our fossil flora and its relations to exotic plants.

Seeing that no one has set foot on the Antarctic Continent, we are not quite sure whether any land animals exist there or not; none have been seen, nor have any land birds, although sea birds are numerous—in fact, the islands lying between 50deg. and 60deg. seem to be the chief breeding places of the albatros. Penguins are very numerous—that is, the common variety ; but there is one species which attains a weight of 75lb. and upwards, which seem scarce.

Whales are abundant, especially within the Antarctic Circle. Ross, Wilkes, D'Urville, and Nares all report having

seen them in great numbers and of very large size. They are of the variety known as black whales, finners, and humpbacks. Sperm whales are reported by Wilkes, but probably he was mistaken, as they do not frequent cold waters. When the whale fisheries were at the height of their prosperity over 100 vessels were engaged, and it is reported that the Samuel Enderby took to England a cargo valued at £40,000.

Three varieties of seals are abundant. The largest one reported was 12 feet long, 6 feet in circumference, and weighed 850lb., yielding 16 gallons of oil. Fur seals are not found in the regions south of New Zealand, and only in limited numbers amongst the S. Shetlands, Kerguelen, and Heard Islands; and, from the accounts of the officers of the Challenger, it would seem that they are being recklessly exterminated by American whalers.

Seeing that parts of S. Victoria Land are bare, and that the climate of Wilkes Land cannot be worse than that of Greenland about Disco, where animals and plants contrive to flourish, it is not unlikely that the main land of the Antarctic Continent may furnish some new contribution to natural history whenever any one is able to effect a landing.

It now remains for me to answer the two questions that must inevitably be asked when any proposals for further exploration in the Antarctic are put before the people of these Colonies. (1.) What is the good to be expected from it? (2.) Why not leave it to others to try? In answer to the first question, we may reply, that independently of any commercial advantages that may result, we must look to the scientific knowledge to be acquired; and it is now generally conceded that the value of scientific investigations is not to be measured by mere pecuniary results. There is a numerous body of scientific men whose business it is to acquire information, to collect facts in various lines of enquiry, and to establish principles. No one can tell what the ultimate results of any particular scientific investigation may be, what practical advantages may accrue from pursuits which at one time seem purely theoretical. The advantages derived by the world at large from the application to every day use of steam, electricity, magnetism, heat, sound, &c., followed after long investigation of principles. Surgery, medicine, chemistry, hygieny, are all benefitting by the labours of men who were looked upon in their day as enthusiastic theorists. Literature, arts and sciences are not cultivated solely for money profit. In this Society we have a zealous band of workers energetically striving to increase our knowledge of the geology, botany, and natural history of the island we live in. Their labours do not add to the value of our exports nor add to the pecuniary wealth of the people, but they are

none the less valuable, and we look with pride on our little volume of Transactions as our modest contribution to the ever accumulating stores of scientific knowledge.

The programme for the proposed Antarctic voyage, as sketched out by our Victorian *confréres*, presents a varied and numerous array of subjects for investigation—subjects on which additional information will be welcomed by the scientific men of all countries. The commercial advantages, too, are sufficiently promising to have induced the Victorian Premier to lend his powerful support to the movement; and I notice that the Premier of Queensland approves of the project, although he doubts if the time is opportune; and seeing that the Geographical Societies of England, Germany, Italy, and Denmark are all anxious to see the work undertaken, I think we may rest assured that some good results will follow, and that we shall be in good company if we join in the work.

Lastly, it is incumbent upon Australia to take part in this exploration. We aspire to be the leading power in these Southern Seas, we are gradually setting up a Monroe doctrine of our own, and we are working ourselves into a perfectly hysterical condition at the bare thought of Frenchmen or Germans poaching upon what we consider our preserves.

All this may be very good policy if we can persuade other nations to see things as we do; but we must make up our minds to act as well as talk, and that it is useless for us to expect the whole force of the British Empire to be exerted in favour of our schemes unless we can prove that our aim is calculated to promote the welfare of the Empire as well as our own. If we expect to be the ruling power in these seas, the sooner we show ourselves upon them the sooner we shall see our claims recognised, and it is only by fostering a spirit of adventure and enterprise that a maritime power can be built up. The great commercial Empire of Great Britain was founded by adventurers who, in the days of Queen Elizabeth, made their way into newly discovered lands, establishing themselves in the most promising regions and defying all efforts to dislodge them. If we wish to build up a maritime power we must follow their example; and if we wish to preserve the islands of the Pacific for our commerce we must turn our attention to forming an Australian Navy and show the Mother Country that we are able to hold what we may acquire. Australia has already shown the Mother Country that she is prepared to share the dangers as well as the benefits of our connection; let us now show her that we are ready to send an Australian Contingent to share her work of science. If we do we may be certain that in this

SOUTH POLAR CHART

SHOWING HEIGHTS OF LAND AND DEPTHS OF SEA

ON LAMBERTS EQUAL AREA PROJECTION

Extracted from the Scottish Geographical Magazine

1886

NOTE

Ocean Soundings in Fathoms	·2500
Soundings, no bottom reached	300
Heights in English Feet	1500
Extreme Limit of Drift Ice	– · – · –
Average Limit of Drift Ice	·····
Limits of Pack Ice	~ ~ ~
Points reached by Explorers & dates	+ Cook 1773

line there is more lasting honour to be gained than in fighting the battles of the Old Country against half-armed savages. No time is more opportune for such a demonstration than the present, when the Colonies are so prominently before the public of the world. We have shown the rapid progress of our commerce and the vastness of our resources. We have proved that in manly sports we can hold our own with all comers; now let us show that the old Anglo-Saxon love of adventure is strong within us, and that although during our infancy we were content to share the benefits of scientific work, in our manhood we are ready to share the toil.

The scientific world is anxious to see a renewal of Antarctic exploration, and nothing would be more gratifying to them, nothing will be more calculated to give the world an earnest of our desire to help, than for Australia to take up this work. Certain it is that it would be a standing disgrace to Australia if she took no part in the exploration of the seas that wash her own coasts. And if Australia determines to undertake this work, I trust that this time Tasmania will act with them.

REMARKS REGARDING COAL SEAM OPENED OUT BY MR. BROCK AT COMPTON, OLD BEACH.

By R. M. Johnston, F.L.S.

Mr. Brock has recently sunk a shaft to a seam of coal, which he discovered indications of at sea margin a little north of Mount Direction.

The seam, about two feet thick, exists under hard laminated blue and grey shales containing abundant impresssions of the following Mesozoic fossil plants :—

Thinnfeldia	obtusifolia	*R. M. Johnston*
Phyllotheca	Hookeri	*M'Coy*
"	Australis	
Pterophyllum	Risdonensis	*R. M. Johnston*
Zeugophyllites	elongatus	*Morris*, very abundant

The shaft is sunk on the southern slope of the rounded hill, capped with variegated sandstones, opposite Austin's Ferry, which rises to a height of about 300 feet. The sandstones, evidently, at one time had spread over the coal seam with associated shales, and all seem to dip slightly in a westerly direction—that is, towards the Mesozoic rocks of a similar character situated on the western shore of the Derwent. Towards the east, the sandstones either abut against or are overlain by greenstones, forming the eastern slope of the same isolated ridge. Beds of a similar character ex-

tend throughout the lower levels towards the Jordan and Brighton.

From the character of the beds and their fossil contents, they may have formed part of the Richmond group.

The following contains particulars of the section sunk by Mr. Brock at Compton :—

SECTION OF BROCK'S COAL SHAFT AT COMPTON, OLD BEACH.

(*a*)	Sandstone...	—
	Sand	8·9
	Clay	6·0
	Grey shale	12·0
(*b*)	Hard laminated blue and grey shales, with impressions of *Zeugophyllites elongatus*, *Phyllotheca Hookeri*, and *Thinnfeldia obtusifolia*	6·0
	Red friable shales	5·0
	Carbonaceous shales	0·3
(*c*)	Coal	2·0
	Carbonaceous shales	0·3
		40·3
(*d*)	Grey friable clay...	
	With P. Hookeri...	—

REMARKS ON THE LONGFORD COAL BASIN.

By Robt. M. Johnston, F.L.S.

The Norwich coal seams near Longford, opened out by Mr. Mason and others, have only been discovered recently, although the existence of the Mesozoic Coal Measure Sandstones in the immediate neighbourhood—notably at Hadspen—had long been known.

The exact extent of this basin of coal has not yet been determined. A glance at the geological sketch map, coloured yellow, shows that nearly the whole of the plains north of the Western Tiers, drained by the Tamar and its tributaries, are superficially composed of sedimentary deposits belonging to an ancient lake or water system of Palæogene age (Lower Tertiary), which deposits were minutely described by the writer in 1873 and 1874, and termed the Launceston Tertiary Basin.*

These Tertiary rocks, with their accompanying intrusive sheets of basalt, together with deposits of tuffs, overlie and conceal the rocks of Mesozoic and Palæozoic age, as in parts of the Derwent Valley Basin.

Rocks of Mesozoic and Upper Palæozoic age are to be found everywhere bordering this ancient Tertiary Lake Basin, and even near its centre, as at Hadspen, Corra Lynn,

*Proc. Roy. Soc. Tas., 1873, pp. 39-47 ; 1874, pp. 53.62.

and Hunter's Mill, Perth, these systems crop up in limited patches.

That the rocks of both Mesozoic and Upper Palæozoic age are most intimately associated with the overlying Tertiaries is apparent from the great abundance of watern-worn pebbles of silicified coniferous woods similar to those of the Jerusalem Basin, and also from the abundance of water-worn fragments of the *Fenestella* mudstones which testify of the close neighbourhood of the parent rock from which they were derived.

The great undulating plains, nowhere ranging much above or below from 500 to 800 feet above sea level, are bounded by the northern face of the Western Tiers as by a mountain wall, and suggest the shore line of an ancient plane of marine denudation. The fringe of marine beds of Upper Palæozoic age, everywhere found along the base of the Central Plateau, also support this idea, although it must be confessed that the evidence of lines of fault running almost parallel with the direction of the margin of the elevated plateau, and throwing the latter up to a great height, greatly complicates the solution of this question.

The coal seams, composed partly of dull and partly of lustrous bands, occurring at Norwich, are of somewhat similar character to certain seams in the Fingal Basin, and however related in point of sequence, it is clear from the abundance of the typical plants, *Zengophyllites elongatus*, (Morris), *Alethopteris Australis* (Morris), *Thinnfeldia obtusifolia* (Johnston), etc., that they belong to the same great Mesozoic system. There are also forms occurring in the greyish white shales at Norwich, which, as yet, have not been disclosed in the members of otherwise closely related basins of the same system.

The following is a more complete list of the plant forms identified by me in the shales associated with the coal seams at Norwich :—

FILICES.

Sphenopteris lobifolia. *Morris.*
Thinnfeldia oblusifolia. *R. M. Johnston.*
" " media. *Ten. Woods.*
Pecopteris caudata. *R. M. Johnston.*
Alethopteris Australis. *Morris.*
Danæa (Tæniopteris) Morrisiana. *R. M. Johnston.*

Equisetaceæ.

Phyllotheca Australis. *Brongt.*
" " Hookeri. *M'Coy.*
Annularia. Sp. indet. (Seed).

Coniferæ ?

Zeugophyllites elongatus. *Morris.* (Very abundant.)

Mr. Blanch Brain has also provided me with additional

information regarding the various beds associated with the coal seams. The principal seam crops out near the Longford and Muddy Plains Road in a creek which runs a somewhat sinuous course, in a narrow shallow valley, between low flattened hills and ridges of greenstone rock. As yet, the ground has not been fully explored, and the relation of the coal measures to the greenstones are not satisfactorily determined, that is—it has yet to be shown whether the greenstones have intruded and spread as caps over the coal measures, or whether the latter forms a small protected basin abutting and running out against the former.

In the latter case the extent of the basin north and east would be very limited or greatly broken up. Mr. Brain has ascertained that the principal seams tend to thin out northward against the neighbouring greenstone hills, while shafts sunk southward on the property of Messrs. Wise and Mason prove the gradual thickening of the seams in a southerly direction, towards which they gently dip. This circumstance had given hopes to many that the beds might be found extending in the direction of the Longford Plains, where there is a great expanse of country apparently undisturbed by intrusive greenstones, although superficially occupied by a great thickness of Tertiary beds composed of clays, lignites, pebble drift, sandstones, etc.

Mr. Ritchie and others have tested the underlying rocks at Longford to a depth of nearly 600 feet by means of the diamond-drill, but with the exception of a greyish sandstone at the greatest depth, whose position is doubtful, the core throughout consisted of sections of the well-known members of the Launceston Tertiary Basin. Bands of lignite, clays, and sandstones, with impressions of *Betula Launcestonensis* (Johnston), and other well-known Tertiary plants, were very common throughout the whole depth of the respective bores. There was nothing to be found in the character of the lowest rocks, composed of a blue or greyish sandstone, which would enable anyone to determine whether it belonged to the Tertiary group or to an older system.

The coal measures may yet be discovered at a greater depth at Longford, although, like at Hunter's Mill, Perth, it is possible that the Mesozoic rocks may have thinned out against the mudstones of Upper Palæozoic age. If coal had been struck at Longford there would be some probability that valuable coal seams existed underneath the greater part of the undisturbed plains of the Launceston Tertiary Basin.

About four shafts, from 20 to 70 feet in depth, have been sunk to the coal seams at Norwich, and a limited quantity of coal has been raised from the principal seam, which varies from 3 to 4 feet in thickness, and the coal, though often

friable, is of very fair quality. In working eastward from the middle shaft there is a curious sign of disturbance, which has bent the seam suddenly into a sharp rounded saddle, and although the continuity of the seam was unbroken, the coal was very much crushed at the sharpest parts of the flexure. It is evident from this that the coal measures have been subject to violent pressure laterally since their deposition. It is impossible to say whether this force was associated with the outbursts of the earlier greenstones or with the later Tertiary basalts, which are also of great extent in the neighbourhood of Evandale and Breadalbane.

The following particulars relating to sections of shafts at Norwich have been supplied to me by Mr. Brain :—

EAST END SHAFT (MASON'S).

	Feet.	In.
Common yellow clay	6	0
Brown coaly shale	0	3
Yellowish or white soapy clay, more or less laminated	6	0
Shaly or rotten coal	1	0
Greyish white clay, with plant remains	2	11
Coal with dull and lustrous bands ...	3	10
	20	0
Fine-grained greyish sandstone ...	—	—

MIDDLE SHAFT (MASON'S).

Shaft.	Feet.	In.
Common yellow clay	6	0
Brown coaly shale	0	4
Yellowish or white soapy clay, more or less laminated	6	0
Hard bluish shale, with *Zeugophyllites elongatus* in great abundance ...	4	0
Lustrous coal	0	3
Hard bluish slate, with *Zeugophyllites*, etc.	2	0
Lustrous coal	—	4
Blue shale...	1	6
Bore.		
Coarse grey sandstone, in which bore was sunk to a depth of	11	9
	32	2

SOUTH BORE HOLE (MASON'S).

	Feet.	In.
Yellowish clay	4	0
Iron gravel	1	0
Yellow clay	3	0
Coarse grey sandstone	10	0
Blue, hard shale, with plant impressions	0	6

Coal...	3	0
Blue clay shales	0	3
	21	9
Fine grey sandstone	—	—

WISE'S SHAFT.

	Feet.	In.
Yellowish-white clay, more or less laminated with impressions of *Zeugophyllites*, etc....	65	0
Coal	4	0
	69	0
Sandstone	—	—

FRESH CONTRIBUTION TO OUR KNOWLEDGE OF THE PLANTS OF MESOZOIC AGE IN TASMANIA.

By R. M. Johnston, F.L.S.

Certain beds of the well-known grey shales have recently been exposed at Lord's Hill, New Town, by Mr. Dorman, builder, who kindly afforded me every facility for their examination. These beds are intimately associated with the beds containing the coal seams at New Town, and as they were unusually full of impressions of plant remains, I spent several days in making collections and in thoroughly examining the numerous forms. The results have far surpassed my utmost expectation, for in the following pages I shall be able to show that about 15 forms of great interest, new to science, have been added to the list of the Mesozoic plants of this island.

The cycadeous and coniferous plants especially are very important, and are more fully discussed under the section where they are specifically classed and described. The genus Baiera is of more than ordinary interest, as I was fortunate in obtaining both the male and female fructification attached to the pedicels of the plants, which are very numerous in these shales, and share with Thinnfeldia obtusifolia, Johnston; Alethopteris Australis, Morris; Neuropteris Tasmaniensis, Johnston; Pterophyllum Strahani, Johnston, in being the most abundant and typical of the numerous forms of plants occurring in great perfection in the shaly beds at the place indicated.

The following is a more complete list of the species observed by me at this place, all of which were obtained within the space of a few yards in width and one or two feet in

depth. Shales of a similar kind, rich in plant impressions, and containing many forms in common, are frequently met with in road cuttings, etc., throughout the districts of New Town, Glenorchy, Old Beach, Richmond, Spring Hill, and Spring Bay. It will be seen that the new discovery has contributed a very important addition to the already known plants of the period.

LIST OF SPECIES OCCURRING IN SHALY BEDS AT LORD'S HILL, OPPOSITE AUGUSTA-ROAD, NEW TOWN.

FILICES.		
*Glossopteris	moribunda	*R. M. Johnston*
Tæniopteris	Tasmanica	,,
*Sagenopteris	salisburioides	,,
*Rhacophyllum (?)	coriaceum	,,
*Neuropteris	Tasmaniensis	,,
,,	antipoda	,,
*Alethopteris	Australis	*Morris*
*	serratifolia	*R. M. Johnston*
Thinnfeldia	obtusifolia	,,
,,	media	*Tenison Woods*
,,	superba (?)	*R. M. Johnston*
*Odontopteris	crispata	,,
Sphenopteris	lobifolia (?)	*Morris*
*Cyclopteris	Australis	*R. M. Johnston*
CYCADACEÆ.		
Podozamites	distans (?)	*Presl.*
*Pterophyllum	Strahani	*R. M. Johnston*
*† ,,	Risdonensis	,,
* ,, (?)	dubia	,,
EQUISETACEÆ.		
Phyllotheca	Hookeri	*M'Coy*
,,	ramosa	,,
,,	Australis	*Brongt.*
CONIFERÆ.		
*Baiera	tenuifolia	*R. M. Johnston*
*Salisburia	Hobartensis	,,
*Ginkgophyllum	Australis	,,
Zeugophyllites (Poa-Cordaites)	elongatus	*Morris*

To this list may be added, for the sake of completeness, the remaining forms known to occur in other formations of the Mesozoic period in Tasmania :—

FILICES.		
Sagenopteris	Tasmanica	*Feist*
Danæa	Morrisiana	*R. M. Johnston*
Trichomanides	Ettingshauseni	,,
Thinnfeldia	trilobita	,,
,,	odontopteroides	*Morris*
Sphenopteris	alata	*Brongt*

* Those marked with an asterisk are new species. † This form occurs at Brock's coal seam, Compton.

LYCOPODIACEÆ.

Lepidostrobus	Muelleri	*R. M. Johnston*

CYCADACEÆ.

Sphenozamites (?)	Feistmantelii	*R. M. Johnston*

Formerly referred with doubt to *Rhacopteris.*

CONIFERÆ.

Coniferous trunks of trees belonging to the class *Taxinaceæ*, to which the Poa-cordaites-like leaves of Zeugophyllites elongatus (Morris) in all probability belong.

Mr. Wintle, who has written many interesting articles upon Tasmanian geology, refers to two other species of plants, viz., *Odontopteris Wintlei*, M'Coy; *Endogenophyllites Wellingtonensis*, M'Coy, but it is probable that they are MS. names, as I am not aware that Prcf. M'Coy has ever published specific descriptions. It is impossible, therefore, to say whether my *O. crispata* now described may not be identical with the form submitted by Mr. Wintle to Prof. M'Coy.

Mr. Wintle informs me that he discovered, years ago, a form which he considered to be identical with *Glossopteris Browniana*, near the same spot.

Table showing approximately the known distribution in time of genera of plants occurring in the Upper Palæozoic and Mesozoic rocks of Australasia.

Characteristic Genera in Australia.	Palæozoic.			Mesozoic.			Cainozoic.		
	Dev.	Carb.	Per.	Trias.	Juras.	Cret.	Eo.	Mio.	Plio.
PLANTÆ.									
Filices.									
Glossopteris* †									
Gangamopteris†									
Tæniopteris*									
Macrotæniopteris*									
Angiopteridium*									
Sagenopteris*...									
Sphenopteris* († ?) ¶									
Trichomanides*									
Aneimites‡									
Archæopteris‡									
Rhacopteris†									
Neuropteris*									
Thinnfeldia* ¶									
Pecopteris* († ?)									
Odontopteris*									
Cyclopteris*									
Alethopteris* ¶									
Merianopteris*									
Gleichenia*									
LYCOPODIACEÆ.									
Lepidodendron‡									
Lepidostrobus*									
Cyclostigma*									
Tasmanites†									
Phyllotheca* († ?) ¶									
EQUISETACEÆ, CYCADACEÆ.									
Podozamites*...									
Sphenozamites*									
Pterophyllum*									
Ptilophyllum*									
Otozamites*									
Cordaites†									
CONIFERÆ.									
Salisburia*									
Noeggerathiopsis† (Rhipidopsis ?)... ...									
Zeugophyllites* (Poacordaites ?) ¶... ...									
Baiera*									
Ginkgophyllum ?*									
Brachyphyllum*									
Walchia*									
Sequoiites ?*									
Cunninghamites*									
Araucarites*									

† In rocks of Carboniferous age.
¶ Occurs in Newcastle beds.
* In rocks of Mesozoic age.

With such important additions to our knowledge of the flora of the Mesozoic rocks of Tasmania, it becomes a question of much interest to enquire how far they shed light upon disputed questions regarding the exact age of the beds in which they are found, and therefore of the age of the upper coal measures of Tasmania and Australia generally.

The comparative tables given showing the wide range of distribution of most of our typical Mesozoic genera indicate that parallelism with the subdivision of distant regions is not such a simple question as some authorities seem to think. It is beset with many fundamental difficulties, among which I cannot too strongly urge the consideration of centres of origin.

Have we any just reason for supposing that there were many centres of origin from whence sprung independently similar genera, and if so, have we also good reasons for supposing that from these several centres identical forms sprang into existence in opposite hemispheres at the same point of time, or even within the same geological period?

Those who agree with Darwin in referring the origin of higher forms of life to one pair (an hypothesis which the author inclines to) would at once reject such a supposition as being opposed to the best evidence. But even should it be admitted that the higher species and genera sprang from one particular pair, have we at this moment sufficient evidence to show, with anything like certainty, at what point of time and in what spot of the earth's surface each particular genus came into existence?

When we consider how small a portion of the earth's surface has yet been examined with sufficient care, and how large is the space comparatively unexplored, he must be bold indeed who would allege that those centres (principally European) where certain species or genera are first known to appear are also the centres of their original appearance as regards the face of the whole globe.

Further, the question of *distribution* over wide areas requires special consideration. It is well enough known that *species* of the lower forms of plant life, such as ferns and mosses amid the vicissities of change of situation, have spread over both hemispheres without such a departure from the central type as would constitute a distinct species; but is this true as regards higher forms, such as cycads and conifers? And even where this question can be answered in the affirmative can we be certain that the distribution of a given species from, say, one hemisphere to its antipodes would be effected within a single geological period, not to mention the difficulties of transfer—natural and physical—which would

act as checks to distribution within the period covered by any one *sub-division* of a system?

It is difficult to answer such questions satisfactorily, but if we take each point carefully into consideration we must arrive roughly at such conclusions as the following:—

1. It is improbable that all species had their origin in one particular hemisphere.

2. It is probable that some species originated in the Northern Hemisphere, while others had their origin in the Southern.

3. It is reasonable to assume when species or genera have spread from the centre of origin to another hemisphere that a considerable period of time must have elapsed.

4. Where such world-wide distribution of forms has taken place we can imagine in either hemisphere their appearance in one local *formation* or *series*, some of them having originated locally within the age of the system or formation, while others were immigrants from an opposite hemisphere, which might date their original appearance to an anterior period in some spot on the opposite hemisphere, where it is natural to expect a wide difference in the form and character of their associates as compared with those to be met with in the subsequent position to which they migrated.

If this very reasonable supposition be admitted, and I do not see why it should be rejected, of what value is the classification of Australian rocks which too slavishly follows the sub-divisions of great periods or systems as they occur in Europe, upon the mere evidence of two or three genera whose association in the rocks of a particular horizon in Europe may only be of local significance? No better illustration of the utter futility of such modes of classification can be given than that indicated by the peculiar association of animals and plants in Australia, within the Upper Palæozoic age, as compared with the associated animals and plants in the European rocks of the same period. For whatever disputes there may have been regarding the relationship of the Upper Palæozoic marine beds of Australia with the lower coal measures, chiefly containing plants belonging to the genera *Glossopteris*, *Gangamopteris*, and *Noeggerathiopsis*, there is now not the slightest doubt but that these plants are as characteristic and are as intimately related with the carboniferous marine beds of Australasia as the characteristic genera *Pecopteris*, *Neuropteris*, *Alethopteris*, *Sphenopteris*, *Lepidodendron*, *Sigillaria*, and *Calamites* are with respect to the carboniferous marine beds of Europe.

Judging from the marine organisms alone there are little difficulties in the way of proving the homotaxial relationship

of the Australasian and European rocks of carboniferous age, for, out of a known list of about 311 Australasian species, we have the high authority of de Koninck for stating that fully 23 per cent. are specifically identical with those of the carboniferous marine beds of Europe. In this instance the results of migration from one centre does not present greater difficulties than could be disposed of by the ordinary interpretation of the theory of homotaxis.

But what shall we say of the plants? Here there is an insuperable difficulty. The common interpretation of homotaxis does not help us much, for there is not the faintest correspondence between the typical plants of the same age in opposite hemispheres. Indeed, it can easily be seen by reference to accompanying lists of plants that there is a greater characteristic relationship between the Mesozoic plants of Australasia with the Carboniferous of Europe than there is between the known Carboniferous plants of the respective regions.

How can we explain this anomaly? For my own part I do not see what other explanation can be given than that already suggested—viz., independent and widely separate centres of origin, producing by slow radiating diffusion subsequently into far distant regions those seemingly inexplicable complications where characteristic types of two separate ages appear to commingle.

This interpretation would help to explain the utter lack of homotaxial parallelism between the marine and terrestrial organisms of Australasia and the corresponding organisms of Europe.

The fact that there is a closer parallelism between the marine remains of the two widely separated regions is probably due to the greater facilities for more rapid diffusion of types among the marine inhabitants of a continuous sea as compared with the slower diffusion of terrestrial organisms, barred as it must often have been by wide tracts of sea and other physical obstructions. This conclusion is borne out by the illustrious Darwin, who states (pp. 229-300, "Origin of Species") :—"The process of diffusion would often be very slow, depending on climatal and geographical changes, on strange accidents, and on the gradual acclimatisation of new species to the various climates through which they might have to pass, but in the course of time the dominant forms would generally succeed in spreading, and would ultimately prevail. The diffusion would, it is probable, be slower with the terrestrial inhabitants of distinct continents than with the marine inhabitants of the continuous sea. We might therefore expect to find, as we do find, a less strict degree of

parallelism in the succession of the productions of the land than with those of the sea."

When Darwin, therefore, refers to simultaneous change of organisms in different ages throughout the world, he expressly states that the meaning must be taken in the broadest sense. Indeed, he affirms, "it must not be supposed that it has a very strict geological sense, for if all the marine animals now living in Europe, and all those that lived in Europe during the Pleistocene period, were compared with those now existing in South America, or in Australia, the most skilled naturalist would hardly be able to say whether the present or the Pleistocene inhabitants resembled most closely those of the southern hemisphere." A more striking illustration might be added as regards terrestrial forms of life, for if we regard the existing characteristic plants—*Banksia, Grevillea, Lomatia, Eucalyptus, Laurus, Cinnamomum*—of Australia the skilled naturalist would find equal difficulty in concluding whether the Miocene or existing terrestrial forms of Europe resembled most closely those characteristic terrestrial forms now existing in Australia. And a still more striking illustration may also be given from Tasmanian rocks of Miocene age, where a vegetation, consisting of oaks, elms, beeches, alders, laurels, etc., prevails, showing a *closer* resemblance to the existing vegetation of Europe than is exhibited by the existing vegetation of Tasmania.

Henry Alleyne Nicholson, in his "Manual of Palæontology," also gives a striking illustration of the danger of drawing hard and fast lines of demarcation between subdivisions of systems in widely separated regions on the basis of European classification. He states (p. 48):—"Moreover, when we come to examine the boundary-line between the Cretaceous and Tertiary in a region far removed from Europe—namely, in North America—we find that between the two formations, so widely separated in the Old World, we have some four thousand feet of strata (the so-called 'Lignitic series') containing such a complete intermixture of the forms of life characteristic of these two periods, that it has been a matter of lively controversy whether they should be regarded as the summit of the older or the base of the newer series of sediments." In New South Wales we have also a similar illustration in the existence of an assemblage of plants, combining in the same formation (Newcastle Beds) the typical forms *Glossopteris, Gangamopteris*, of the lower carboniferous coal measures, with the typical forms *Phyllotheca, Sphenopteris*, and *Zeugophyllites* of the more recent Mesozoic formations, and hence we must concur with Prof. Nicholson in the statement (pp. 45, 46), "and therefore we

cannot parallel the *sub-divisions* of such formation with anything approaching to absolute precision. Regarded as a whole, however, the Carboniferous formation of America is the geological equivalent of the Carboniferous formation of Europe." Of similar value are the utterances of W. T. Blanford and Prof. Hutton. The former urges that in India "the breaks in the sequence do not correspond with those especially remarkable in Europe." The latter boldly affirming, in respect of New Zealand, a truth which, in my opinion, is equally applicable to Australia and Tasmania, viz., that "we can always speak of the 'Palæozoic' or the 'Mesozoic' rocks of a country with all the accuracy required when using such terms, while we cannot always do the same with sufficient accuracy when referring to rocks belonging to the shorter periods or epochs."

I have on a former occasion observed that Palæontology divorced from facts of *local* stratigraphy is most unsatisfactory, for we have the authority of Huxley ("Lay Sermons," p. 234) for the statement, "All that geology can prove is *local order of succession.*" The question of distribution from one geographical centre to its antipodes is also complicated by the tendency in later periods to an increase in number and variability of species, involving a greater risk in the increasing struggle for *specific* existence over wide areas. This is plainly indicated by the fact that while the molluscs of the Carboniferous period in Europe and Australasia have at least 23 per cent. of the *species* in common, the molluscs of the tertiary period in the same regions have not even *one* per cent. of the species in common.

Of course English geologists have not had this aspect of the case pressed home so closely to them in a practical way, because unlike Australian geologists they have not been hampered in their schemes of local classification by dependence upon the widely differing association with respect to the stratigraphy and palæontology of a far distant region. Had they to form their sub-divisions of systems with dependence upon the associations of Australasian stratigraphy and palæontology the difficulties of the matter would have at once become apparent to them as it now appears to Australasian geologists.

With these facts and considerations before us I cannot but express my strong conviction that it would be unwise to accept the triple sub-division of *Triassic*, *Jurassic*, and *Cretaceous*, for the Mesozoic rocks of Australia and Tasmania, as such triple sub-division does not in the remotest degree harmonise with the local facts of either stratigraphy or palæontology.

In Tasmania there is no break showing alternations of sea

and land throughout the whole series of formations belonging to the Mesozoic period, and typical specific forms persist throughout all the separate groups which, from their extent, indicate a vast period of time. The great sameness of forms of vegetable life throughout presents a great difficulty in breaking up our scattered formations of this age into geological subdivisions, and I, at least, am as yet far from prepared to indicate any satisfactory lines whereby the whole series could even be separated into superior and inferior groups. In time, when the distribution of certain forms can be more exactly determined, a simple method of grouping, having a local significance, may be adopted with advantage; but in the meantime I am convinced that it is only on the broad lines of systems that we can suggest parallels with European and other distant regions.

DESCRIPTION AND REMARKS REGARDING NEW SPECIES, Etc.

DESCRIPTION OF NEW SPECIES.

FILICES.

Glossopteris (?) moribunda, Nov. sp.

I have discovered two fragments of a small species associated with the common Mesozoic forms at the shaly beds at Lord's Hill, New Town. It is not certain that they may yet prove to be a form of Sagenopteris, as their bases were both imperfect. The largest fragment is 42 millimetres long, 13 millimetres at its broadest part near the top, and 9 millimetres at the base of fragment, to which it gradually tapers; midrib distinct, from which branch off at an acute angle about 12 principal nerves in the length of fragment. These nerves, after acutely ascending from midrib, curve and branch outward dichotomously and flexuously, forking two or three times before reaching margin, anastomosing at each fork. The meshes, however, are more open than in the larger forms of *G. Browniana* from the lower coal measures, and the nerves appear to be more raised and wrinkled. The frond itself also appears to be more coriaceous and fleshy.

As indicated by the measurements, the frond is somewhat linear-spathulate in form. In the smaller specimens the spathulate appearance is far less pronounced. They are unlike any description given of *Sagenopteris rohifolia* or *S. Tasmanica*, and apart from the circumstance that their bases and mode of insertion are unknown, they seem to me to be more akin to the genus Glossopteris, to which they have been provisionally referred. It would appear, therefore, that these rare forms are the dwarfed or degraded descendants of that genus which gave such a peculiar character to the

shales of the lower coal measures by its wonderful profusion, and are an indication of the fast approaching extinction of the genus in Australian rocks.

It is of additional interest in connection with this genus that Erough Smith many years ago obtained a specimen of *Glossopteris*, stated to be *G. Browniana*, from beds of nearly the same horizon at Spring Hill. It is possible that the two forms may be closely allied. I am not aware whether the Spring Hill specimen has ever been figured or described. It would be of interest if both forms could be compared closely together.

Sagenopteris salisburioides. Nov. sp.

Frond, palmate or flabelliform, membranous, quadrilobate; the median division is wide, and the frond is thereby deeply cleft to base; the two lateral divisions are simple incisions to nearly the middle of frond. Segments entire wedge shaped; the principal ones very much contracted at base, almost pedicellate. Apices of segments truncate, with margins either crenulate, undulating, or simple. Nervules springing from two or three prominent nerves at peduncle, and rapidly spreading dichotomously into fine branching venules towards the upper margin, anastomosing frequently. No approach to a central rib on any segment.

Fronds variable in size but constant in general form. One of the smaller perfect forms measures 30 millimetres in breadth and 25 millimetres in length, but there are specimens occurring in fragments fully twice this size. At first sight the plant would seem to be a species of *Salisburia*, as in form it closely resembles *S. Huttoni* Sternb. from the Lower Jurassic of Europe.

Not uncommon in dark grey shales at Lord's Hill, New Town.

Rhacophyllum coriaceum. Nov. sp.

I have doubtfully placed a peculiar form under the above genus for the sake of reference, as it is of frequent occurrence in the Mesozoic rocks at New Town, Spring Bay, and elsewhere. The fronds are generally imperfect, and they are very variable within certain limits.

Frond or pinna simple, rarely distantly lobed, linear or linear lanceolate, very attenuate at the base, gradually but slightly widening towards obtusely rounded apex, usually forking at a very acute angle into two secondary linear pinnæ which preserve the same character as the principal one. Mid rib marked by a shallow central groove in the coriaceous and fleshy-like frond from which the acutely angled nerves can be traced with difficulty. Margins of secondary pinnæ, sometimes obsoletely lobed, but more frequently entire;

the greatest breadth is attained towards apex of secondary pinnæ, where it usually measures about from 4 to 10 millimetres. Extreme length of specimens about 5 inches.

Neuropteris. Brongt.

Fronds pinnate or bi-tri-pinnate generally twice or thrice divided. Pinnules entire, constricted at the base, and not uncommonly cordate with a short pedicel, rarely inserted by the whole width of the base, costa more or less distinct, only occasionally continuous beyond the middle of the pinnule, thence dividing into veins which emerge at a very acute angle, curved, diverging. Numerous slender dichotomous produced to the margin in parallel venules, and never anastomising.

Neuropteris Tasmaniensis. Nov. sp.

Frond bi- or possibly tri-pinnate; pinnules sub-opposite, generally constricted at base or sub-pedicellate, sub-distant; polymorphous, being either ovate, oblong-ovate, sub-hastate, panduriform, lozenge-shaped or dolabriform, and frequently auricled or lobed at base on one or both sides, and occasionally lobed towards apex; the middle series are generally larger and more symmetrical, usually oblong-ovate, and are attached to rachis at right angles by their constricted bases; the upper series are more oblique, and at the very extremity of one of the pinnæ the lobes are very oblique, simple, ovate, adnate; towards the base the inner lower pinnules (two to four) are rudimentary, rounded, shortly spathulate, or lozenge-shaped; the outer basal lobes are larger, generally auricled or lobed, oblong-ovate, or panduriform. Costa more or less distinct on the more elongate pinnules, continuous to near the extremities, from which numerous lateral nerves diverge arcuately at a considerable angle forking once or twice before reaching margin. Costa absent in the short rudimentary pinnules at base and apex of pinnæ.

Rachis comparatively thick; traversed longitudinally by wrinkled striæ.

Average length of pinnæ on specimen described about 5 inches; greatest breadth across pinnules about 40 millimetres; largest pinnules about 21 millimetres long and 8 mil. broad; smaller pinnules, 4 to 7 mil. long and 6 to 7 mil. broad.

The sub-pedicellate attachment and the fantastic shape and distribution of the pinnulæ bring this interesting species near to *N. valida* Feist, of the Lower Gondwanas of India. It differs from this species, however, in its branching habit and its much smaller proportions.

Dark grey shales, Mesozoic coal measures, Augusta Road, New Town, Hobart.

Neuropteris antipoda. Nov. Sp.

Frond pinnate (or bi-pinnate?); pinnæ probably linear-lanceolate; pinnules coriaceous, slightly falcate, symmetrical, regular (seven in the space of 40 millimetres), alternate, slightly angled, ovate-lanceolate, closely set, subauriculate, and only attached to rachis by a very short pedicel. Costa fine and flexuous but distinct, continuous beyond middle of pinnule; secondary nerves arising from costa and reaching margin at an acute angle, few, distant (about six pairs), alternate, flexuous, dichotomous.

Breadth of pinna, about 36 millimetres; breadth of pinnula, 6 to 7 mil.; length of pinnula, about 19 mil.

This distinct form approaches *N. gigantea* Brongt., but the small number of nerves is very exceptional, and is very characteristic.

Dark grey shales, Mesozoic coal measures, Augusta Road, New Town.

Alethopteris serratifolia. Nov. sp.

Frond bipinnate; pinnæ very oblique, sub-alternate, distant; pinnulæ rather coriaceous-lanceolate, falcate, and somewhat obtuse, oblique, slightly incurved, closely set or adnate, decurrent, dilated towards base where crispate, margins often overlapping are strongly distantly dentate or serrate; midrib somewhat flexuous, rather thick, evanescing towards apex; veins oblique, rather distant, forking once or twice before reaching margin. Stipes with two well-marked grooves, giving an angled appearance; rachis usually with one central groove; average distance apart of pinnæ, 27 millimetres; breadth of pinnæ, about 28 millimetres,near to rachis; average length of medial pinnæ, about 8 inches; length of larger pinnulæ, 17 millimetres; greatest breadth at base, about 7 millimetres; breadth of stipes, $3\frac{1}{2}$ to 4 millimetres; length of fragment, 10 inches. Occurring in shaly beds at Lord's Hill, New Town.

This form is very handsome, and is easily distinguished from *A. Australis* by its more robust appearance and its crisp or sinuous dentate pinnulæ. In some respects it approaches *A. currani* (Ten. Woods), but its more robust form the greater size of the pinnulæ, and the more coarsely and continuously dentate margins, easily distinguishes it from that species.

Genus Odontopteris. Brongt.

Fronds pinnate; generally bi-pinnate at the apex. Pinnæ, pinnate, and pinnatifid. The apical ones single, sub-opposite, and sub-alternate, linear-lanceolate; pinnules obliquely inserted by the whole base; decurrent free, but towards the

apex more and more confluent, and the terminal ones united, slender, ovate-accuminate, rarely somewhat rounded, the lowest ones seated partly on the primary and partly on the secondary rachis of two forms, either narrow at the base, broadly cuneate, and more or less deeply emarginate above or obcordate. Veins all arising from the rachis, extremely fine, dichotomous, diverging as they ascend. No costa. Fructification unknown.

Odontopteris crispata. N.S.

Frond imperfect; pinna, linear-lanceolate, with undulating or pinnatifid lobes obliquely inserted upon rachis; pinnules or lobes crispate, with undulating margin sub-opposite, obtusely and obliquely rounded; length, twice the breadth; lower margin longest and very oblique; veins all arising from the rachis, closely set, but sharply marked; once forking at base or near the middle of the scarcely pinnatifid lobe. The veins follow the same highly oblique angle as the lower margin of lobe. Rachis thick with a continuous sub-central groove. It is evident from the absence of free lobes that the portion of pinna described was situated near the apex of frond. Greatest breadth of pinna, 16 millimetres. Greatest length of base of undulating lobe, about 16 millimetres.

Greyish black shales, Augusta Road, New Town.

Sphenopteris lobifolia. Morris.

S. hasta. M'Coy.
S. germanus. M'Coy.
S. plumosa. M'Coy.
S. flexuosa. M'Coy.
S. creba. M'Coy.

In the shales at New Town there are abundant remains of a fine large fronded species of Sphenopteris, which at first sight I was disposed to consider belonged to a new species, but a more careful diagnosis now strongly inclines me to believe that it is a very variable form whose pinnulæ are simple, free, or pinnatifid, serrated, incised, or variously lobed from 1 to 5 on each side in extreme cases, according to their situation on the pinnæ, the latter themselves varying accordingly as they are situated towards base, middle, or extreme apex. The neuration partakes in this tendency to vary with the form and situation of the pinnulæ.

From several fine specimens I am able to estimate that some of the fronds measured at least over 1 foot in length,

with greatest breadth towards middle of from 4 to 5 inches. There are 27 pairs of alternating pinnæ disposed on either side of the principal rachis or stipes diminishing gradually to either extremity, where they are reduced to variously lobed pinnulæ. The whole shape of frond is therefore broadly lanceolate or ovato-lanceolate-acuminate. At the base of the lower middle pinnæ the pinnules answer to Morris's *S. lobifolia*. The basal pinnules of immediately succeeding pinnæ answer to M'Coy's *S. hastata* and *S. flexuosa;* towards apex where the pinnæ are themselves reduced to pinnulæ examples could be found corresponding to M'Coy's *S. germanus* and *S. plumosa;* while in the greater number of intermediate pinnæ the following description for *S. crebra* (T. Woods) would equally serve for the pinnules of our abundant Tasmanian form, viz., "pinnules so close together as not to be easily distinguished, faintly pinnatifid; lobes a little more oblique than the pinnæ, oblong-ovate, with a slight undulating margin; costa sending off veins which fork once, and the venules reaching the margin." This being so, I shall be inclined to regard the various species named as so many varied parts of our variable form, that is, so long as it remains uncertain that the features which characterise the fragments hitherto erected into separate species are persistent throughout the whole frond of perfect specimens.

Cyclopteris Australis. Nov. sp.

Frond large, graceful, broadly rounded and flabelliform, divided towards extremities into seven or eight digitate segments. Segments somewhat cuneate, with irregularly truncate and crenulate margins. The nerves spring from a common centre at base of flabellate frond, where they compose about five primary groups, each one breaking up dichotomously into four branching venules, these again forking once or twice before reaching the extreme margin of the incised lobes. The nerves are fine and rather widely spreading, although firm and well marked, as in the existing *Trichomanes reniforme*, Forst.

Greatest breadth of frond, about 90 millimetres; greatest length, about 75 millimetres; breadth of segments, from 10 to 15 millimetres. Dark grey shales, Augusta-road, New Town.

ZAMIEÆ.

Genus, Pterophyllum.

Fronds probably caducous, pinnate; segments elongate, linear, firmly inserted at an angle by their whole base upon the rachis, but separate from each other, but truncate to the apex. Nervules simple, equal, parallel, reaching to the apex of the truncate pinnules.

Pterophyllum Strahani. N.S.

Frond imperfect; large, sub-alternate; pinnules moderately broad, linear, sub-opposite, roundly truncate at extremities, distant and horizontal towards middle and base; approximate almost confluent, and becoming highly angled towards apex of frond; each pinnule inserted by its whole base; bases confluent, curving, and broadening out into a narrow wing against rachis, between the middle and inferior pinnules; sinus rounded between the lower distant pinnules. The pinnules vary considerably in breadth, and some of them (three in specimen described) are cleft from the middle to the apex. Nerves, fine, parallel, dichotomous, about 8 to 16, according to breadth of pinnule; rachis thick grooved and striated. Lower and middle pinnules from 65 to 80 millimetres long, and from 12 to 15 millimetres broad.

Dark brown shales, Augusta-road, New Town, associated with *Salisburia, Baiera, Tæniopteris, Cyclopteris, Sagenopteris, Alethopteris, Thinnfeldia, Sphenopteris, Odontopteris, Zeugophyllites*, etc.

This remarkable fossil plant approaches close to *Pterophyllum Morrisianum*, Oldham, from Bindrabun, Rajmahal, India, and suggests affinities with European plants of Liassic age. The extraordinary association of genera in Australasian rocks of Mesozoic age, however, makes it hazardous as yet to fix the exact position of these Tasmanian beds from the association of genera in the opposite hemisphere. Considerations regarding the centres of origin, as indicated by the first appearance of *Glossopteris* in Upper Palæozoic of Australasia, suggest much caution in any attempt to break up our Mesozoic rocks into minor divisions corresponding with the sub-division of European rocks of the same system.

I have named this fossil plant in honour of His Excellency Sir George Strahan, K.C.M.G., Governor of Tasmania.

Pterophyllum Risdonensis. Nov. Sp.

This is a species occurring very abundantly in shales associated with Brock's coal seam at Compton. The fronds are too imperfect to give a proper description, although the fragments show that the species is larger and very distinct from *P. Strahani*, from New Town.

The leaflets are broad, linear, closely set, and inserted upon rachis by their entire bases; extremities truncate or obtusely rounded; nerves strong, parallel, not dichotomous, about 6 in the breadth of each leaflet; the nerves are thus wider apart than in P. Strahani.

Pterophyllum (?) dubia. Nov. sp.

Leaf elongately oval, margins apparently entire, and not divided into segments; nerves very fine or obsolete, sunk in the hard coriaceous integument, but the course of which can be traced by close, gentle, regular, parallel undulations, proceeding from fine but strong midrib, at a moderately acute angle.

It is difficult to find the true alliance of this very peculiar species. Its form is suggestive of *Macrotæniopteris*, but the character of its nerves, and its simple margin which seems to be bordered by a hardened edge or a continuous marginal nerve, leaves one in little doubt of its cycadeous nature.

It is a small specimen, imperfect at the base, and it is significant that at the apex of *Pterophyllum Strahani*, mihi., the segments seemed to coalesce. Greatest length, about $3\frac{1}{2}$ inches; greatest breadth, about 35 millimetres.

It is possible, therefore, that this may be a rudimentary frond of an allied species. The description, however, now given will enable others to identify the form, which is very peculiar, and it is now named provisionally for the sake of reference.

CONIFERÆ (Section Taxees—Renault).

Genus Baiera.

Leaves coriaceous, or more or less cartilaginous; divided from the base into narrow linear segments traversed by numerous fine parallel nerves. The nerves are finely divided, and although at first sight they appear to be dichotomous, they are long and simple in accordance with the length of the segment. Female flowers are disposed at the extremities of the pedicels several times bifurcate. Seeds articulated upon the dichotomous divisions, and the ovate bearing shell or covering swollen or inflated, much smaller than the cells of the *Salisburia*. Male flowers, formed out of the outer woolly covering, numbers of which bear towards the extremities of branchlets 5 to 7 pollen clusters.

Baiera tennifolia. Nov. Sp.

Leaves coriaceous, divided dichotomously from base, like the branching nerves of a fern, and superficially resembling *Sphenopteris linearis*, Carruthers.

Segments narrow, linear, threadlike, traversed by roughly wrinkled nerves, which appear to be dichotomous or discontinuous, but which traverse the whole length of the furcate segments. Greatest breadth of segments varies between one and two millimetres. Fragments of leaves from the three to eight inches in length are very numerous in dark grey shales

at New Town, Richmond, and Spring Hill, associated with Alethopteris Australis, Thinnfeldia obtusifolia, and other common Mesozoic form.

Associated with the larger fragments I was fortunate in obtaining the male and female fructification, which perfectly corresponds with the characteristic description given under the genus. The female fruit, drupe, or nut, is small and round, exserted on the extremities of one of the bifurcating branchlets, which are evidently modified into paired fruiting pedicels, one seed to each pedicel. The pair of short pedicels are symmetrically recurved in opposite directions; the male flower consists of minute clusters of bract-like scales or anthers, attached to a common pedicel, and evidently radiating from a common centre. Several pedicellate clusters near to each other towards the extremities of branchlets. The scale-like bracts are generally ovate and slightly wrinkled. There can be no doubt, therefore, of the reference to *Baiera*. Diameter of seed, about 3 millimetres; length of fruiting pedicel, about 8 millimetres. It is very probable that the plant from Queensland described by Tenison Wood, and classed among ferns as *Jeanpaulia bidens*, is a species of *Baiera*. The Tasmanian species is very graceful in form, and is one of the most abundant plants occurring in the Mesozoic shales at New Town.

Genus Salisburia.

Foliage springing from petiole, spathulate or flabellate, more or less developed towards the extremity; outline of fan rarely simple. Margin crenulate, very frequently its lobes are deeply and dichotomously divided and traversed by numerous nervules.

Salisburia Hobartensis. Nov. sp.

Frond imperfect. (Comp. *S. lepida*, Heer. One of the principal divisions only preserved in the specimen now described.) Principal lobe deeply cleft into two lanceolate segments. Nervules traversing, each lobe fine dichotomous. It is probable that the perfect frond would possess from 6 to 7 principal spreading lobes, each of which would be cleft as in the pair described. Length of each segment about 50 millimetres.

Genus Ginkgophyllum. Saporta.

Branches thick, bearing long cuneiform leaves, which are narrowed into a petiole at the base, decurrent, divided into dichotomous segments; nerve distinct, fine, and closely set.

Ginkgophyllum Australis. Nov. sp.

For the sake of reference I have ventured to give this name to fragments of a plant appearing in the shaly bed at Lord's Hill, New Town, associated with *Baiera*, *Salisburia*, *Pterophyllum*, Thinnfeldia, etc.

It consists of the terminal or rudimentary cluster of cuneate leaflets corresponding very closely to some of those attached to plant *G. Grasseti*, Sap., figured and described in "Cours de Botanique Fossile," by M. B. Renault (Paris, 1885, pp. 67-68, pl. 3, fig. 1.)

Leaves grouped in a curving, clasping cluster, decurrent, segments narrowly cuneate, dividing dichotomously into a crowded head of diminishing segments, some of which are truncate at apex, others obtusely rounded, and all more or less incurved.

The character of the genus is well-marked in these respects, and in the thickish fleshy appearance of the dichotomously divided leaflets, each of which is traversed longitudinally by fine but distinctly marked nerves, which, at the termination of the more obtusely-pointed ones, gradually coalesce. Length of average segment, 13 millimetres; greatest breadth, about 3 to $3\frac{1}{2}$ millimetres. Five successively branching segments in the space of 18 millimetres. Together with these I discovered one or two impressions of larger curved, short, broad, cuneate segments, truncate above, traversed by numerous fine, closely set nerves.

The fragment appears to be much curved, as if its petiole were affixed to stem in a decurrent clasping manner. It is only a fragment, however, about 27 millimetres long; 21 millimetres broad at its convexly truncate apex; and narrows to 14 millimetres at the base of the fragment. It is possible that it may be the terminal part of one of the larger segments placed lower on the stem of *G. Australis*. I think in the meantime the reference to the genus *Ginkgophyllum* is fairly justifiable. It is interesting to observe that this genus is associated with the rocks of Permian age in Europe.

Branchlet of a Supposed Conifer.

I figure a small branchlet of what may be a conifer, also from the shaly beds at Lord's Hill, New Town. The branchlet is about 80 millimetres in length, composed of a central simple linear stem, from which arise at an acute angle about 6 pairs of sub-opposite filamentous branches, each about from 30 to 35 millimetres long. The stem is a little over a millimetre broad, swelling out slightly where the branches emerge; the breadth of the branchlets are less than a milli-

metre, and preserve the same thickness throughout to their blunted extremities.

I have not attempted to name this specimen. It may be an *Abietites* whose minute branches may have lost their leaflets.

Zeugophyllites elongatus. Morris.

Stem (?), leaves petiolate, oblong elongate, entire truncate, and slightly thickened at the base; veins distinct, equal parallel.

When Morris described the above species from the Jerusalem Basin he was uncertain as to its affinities, and it is now for many reasons probable that its true alliance is rather with *Poa-cordaites* among the *Coniferæ*.

So far as the prevailing Tasmanian forms are concerned the following description of *Poa-cordaites* would serve equally well with the specific description given by Prof. Morris:—

Genus Poa-cordaites. Grand 'Eury.

Leaves, narrow linear, very long, entire slightly attenuated and obtuse at the apex, traversed by almost equal nerves, parallel not dichotomous, connivent at the base, apparently fleshy.

It is true that M'Coy doubtfully refers the genus to palms, while Tenison-Woods suggests alliance with the cycads near to Podozamites. My own opinion is strongly in favour of a coniferous alliance under *Poa-cordaites*, because of the intimate relation which these linear leaves have with abundant stems and trunks of conifers which, from their beautifully preserved structure, can be referred to the same family *Taxineacæ* (Renault).

There is the remains of a perfect forest of these coniferous trunks in the Jerusalem Valley in the same formation where these *Poa-cordaite*-like leaves are so remarkably abundant. Throughout the whole range of the Mesozoic rocks of Tasmania it is significant that these leaves and coniferous trunks abound. I think, therefore, that the leaves of *Zeugophyllites elongatus*, Morris, belong to the coniferous trunks with which they are everywhere so intimately associated. No other coniferous foliage is found in most places where these trunks are in such profusion.

Genus, Noeggerathiopsis.

Leaves (pinnules or segments ?) wedge-shaped or elongate-spathulate, sub-rhomboid or obovate, margins straight or incurved; nerves close and numerous, somewhat thick at the base, and from thence forking twice or oftener, becoming slender and diverging.

Dr. Feistmantel, who has so ably elaborated the Indian fossil plants, erected this genus to include certain peculiar forms which had been previously classed as *Noggerathia*, which, though of doubtful position, is usually referred to the conifers. As regards the position of *Noeggerathiopsis* itself, Dr. Feistmantel is not quite certain, although he inclines to the opinion that it is the leaf of a cycadeous plant. The late Prof. Heer, on the other hand, regarded the closely allied forms classed as *Noeggerathieæ* as belonging to the coniferæ; and Dr. Feistmantel also refers another somewhat similar form *(Euryphyllum)*, associated with *Noeggerathiopsis* in the Talchir Karharbari beds of India, to the coniferæ. Dr. Feistmantel further considers the reference of *Noeggerathiopsis* to *Cycadeæ* with such doubt that he considers it possible (Mem. Geol. Survey, India, ser. xii., 1879, p. 26) that Noeggerathiopsis may yet prove to be closer to the *Coniferæ* than to the *Cycadeaceæ*, and in such case he suggests they would perhaps represent other species of *Euryphyllum*, which he classes as belonging to the coniferæ.

My present object in drawing attention to this matter is to make further suggestions why *Noeggerathiopsis media*, so abundant in the lower coal measures of Tasmania, should be regarded as a conifer rather than as a cycad.

In the first place there exists in great abundance in Tasmanian carboniferous rocks coniferous trunks of trees, often of great size. One in particular at One Tree Point, Bruni Island, must, at least, have been 40 feet long, and 4 feet in diameter. The only foliage yet discovered associated in the same rocks with these coniferous trunks are the abundant forms of *Noeggerathiopsis*.

If, therefore, the latter be not the foliage belonging to these very abundant silicified trunks of conifers, it is strange that no other trace of coniferous foliage should fail to be disclosed when such forms as *Glossopteris* and *Noeggerathiopsis* occur in such wonderful abundance.

I am all the more inclined to relate the coniferous trunks with the *Noeggerathiopsis* foliage, when I regard how closely the latter corresponds with the coniferous genus *Rhipidopsis*, Schmalhausen, which is described as follows:—

Leaves supported by a very long petiole, coriaceous, palmate, digitate. Segments varying from 6 to 10 entire, those of the middle part extending much beyond the lateral segments, cuneiform almost pedicellate, truncate towards the exterior margin, traversed by numerous nerves repeatedly bifurcate. Fruit in the form of a drupe, but internally striate.

It is further of significance that the fruit of *Rhipidopsis ginkgoides*, Schmalhausen, is almost identical in appearance with certain winged seeds which are invariably found in more

or less abundance wherever *Noeggerathiopsis media* is found in Tasmania. Taking all these matters into consideration, I am strongly inclined to regard *Noeggerathiopsis* as the foliage, and the winged seeds as the fruit of the coniferous trunks referred to.

Thinnfeldia (Pecopteris) Odontopteroides. Morris.

The original descriptions by Morris are as follows :—

Frond pinnatifidly bipinnate or flabellate? Pinnæ linear, elongate, acuminate; pinnulæ opposite, approximate, adnate, obtuse, entire; veins nearly obliterated.

Prof. Morris also adds that his specimens were embedded in a coarse sandstone, and that he could trace a central depression indicative of a midrib, from which secondary veins radiated. Some of the pinnules in specimens examined by him are stated to have been "more lanceolate shaped," and he considered such forms to be only a "variety" of the one figured. In all these references there is no indication to the smaller form with forking pinnæ and small obtusely rounded pinnules devoid of anything approaching a midrib named by me as a variety under the name *T. obtusifolia.*

Through the kindness of Mr. Robinson, of Spring Bay, I have had the opportunity of examining a large and varied collection of the original types of forms from sandstone at Okehampton. They correspond in every respect to Morris' original descriptions.

In all the variations there is not the slightest approach to a form showing forked pinnæ, nor do they in any way show intermediate forms approaching the form *T. obtusifolia.* In all the pinnules there is clear evidence of a distinct and rather strong midrib, and in this respect differing widely from the finely nerved pinnules of *T. obtusifolia,* which are always free after leaving margin of rachis, approaching the nerves of the genus *Odontopteris* in this respect.

As the latter is the prevailing form in the shales associated with the coal at New Town, Compton, York Plains, Longford, Mount Nicholas, etc., and as the two widely forms have never been found by me together in the same beds, I am inclined to consider them as distinct species. The original form of Morris's *T. odontopteroides* is readily recognised by its more robust and coriaceous appearance, and especially by the deeply-furrowed midrib on the long linear ovate or lanceolate-ovate pinnules.

APPENDIX.

"I adhere to my old divisions under a belief confirmed by subsequent survey that in many regions of the earth the geolo-

gist will find it impossible to classify by the means of such smaller sub-divisions." (Sir Rod. Murchison, Siluria, p. 51.)

Ideal Distribution of Genera in Time from independent or widely-separated geographical centres.

On the hypothesis that all organic genera did not arise and radiate repeatedly from one geographical centre only, and that a considerable space of time would be consumed in the greater extremes of distribution as regards terrestrial plants of higher organisation, the following diagram is designed, roughly illustrating the possible complication arising out of the radiating distribution of genera from widely-separated centres; and also illustrating the different nature of the possible associates to be met with at different stations should the survivals succeed in reaching a middle station or the antipodes of the place of their generic origin.

The cross dotted lines indicate the possible lapse of geological time between the commencement and close of the migration of each genus, and also the curious interweaving of different genera which originated in centres widely apart.

NOTES ON A RECENT CASE OF POISONING CAUSED BY THE EXHALATION OF RHUS RADICANS (TOXICODENDRON) AT THE BOTANICAL GARDENS, HOBART.

By F. Abbott, Superintendent Botanical Gardens.

A very peculiar case of poisoning, caused by plant exhalation, having occurred at these gardens, it is desirable that it should be recorded, not alone for general information, but more especially as it is possible that the plant in question may, to a limited extent, be under cultivation in other places.

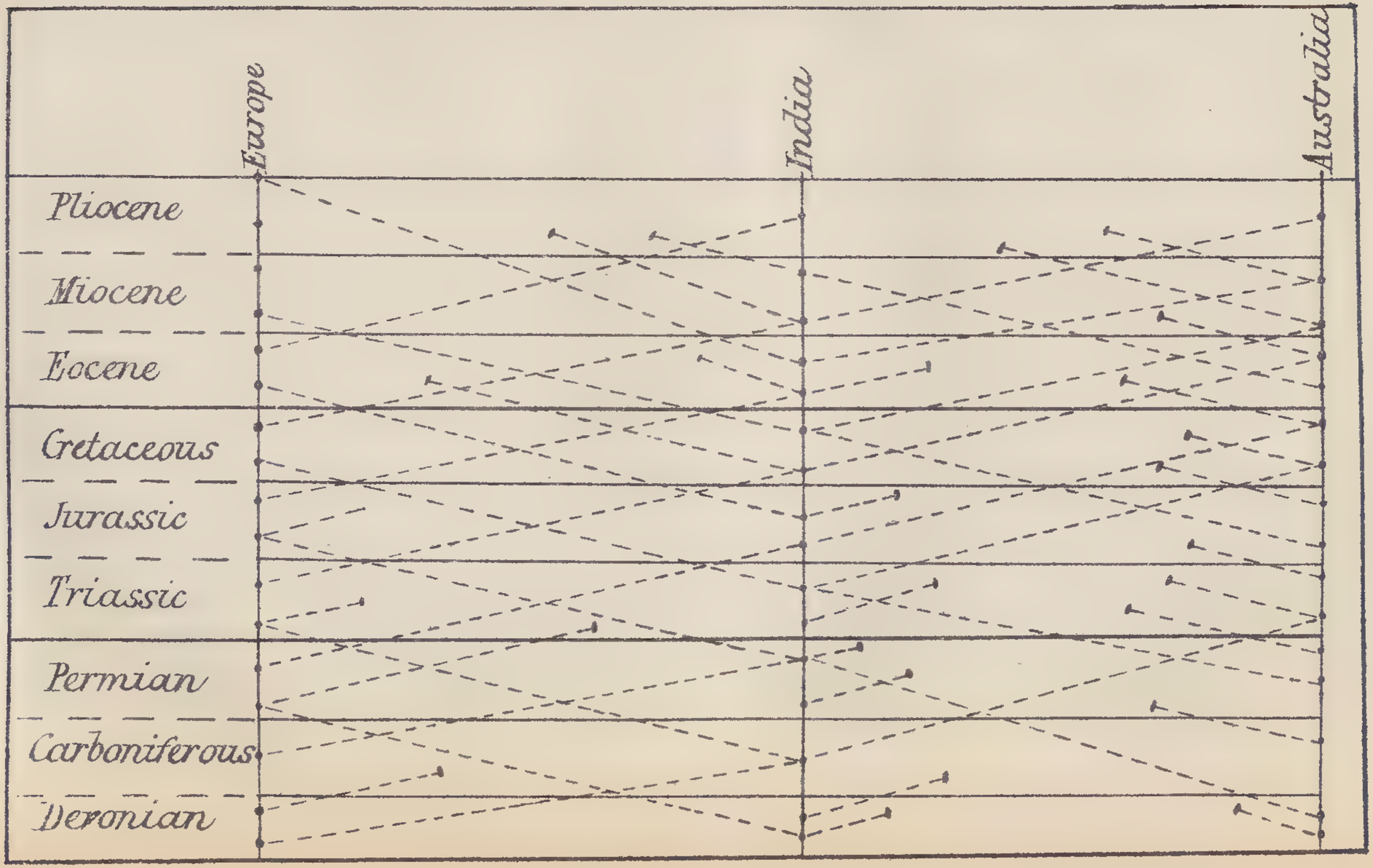
Before describing the case, a few general observations relative to the matter may not be out of place.

The genus Rhus embraces numerous species, many of which produce gums and resins used in the manufacture of superior kinds of varnish. R. verincifera yields the very best japan varnish; others are rich in tannic matter, and are esteemed for the preparation of leather, while not a few of the species are poisonous to a greater or less degree, R. pumila, of Upper Carolina, being the most pernicious of them. A case is reported where the mere gathering of seeds from this species resulted in the poisoning of the whole body, and produced lameness, which lasted for a considerable time. Rhus

Ideal Distribution of Genera in Time

From independent widely separate centres

by R. M. Johnston



venenata and R. radicans are also poisonous to some persons, but not to all alike. The latter of these species, Rhus radicans, is the plant which caused the poisonous effects described in these notes.

The plant is common in North America, where it is known as poison ivy. The air impregnated with its volatile exhalations is capable of poisoning many persons, more especially in hot weather, causing a kind of violent erysipelas, accompanied by erysipelatous eruptions. Some persons are wholly unaffected by it, and a case is given where one member of a family could handle the plant with impunity, while another would be affected by mere proximity alone without contact. Persons of irritable temperaments are said to be more susceptible than others.

The particular plant in question has been in the garden for many years. I am unable to say how it was obtained, or whether more were received at the same time or not. For some thirty years it has occupied the same position in the gardens, and for a long time was without specific name, being known as Rhus species. Later, on examination, I believed it to be Rhus radicans, the only doubt in the matter being that it had not, so far as I was aware, exercised any poisonous effects at any time.

The natural habit of the plant is to spread and root on the ground like ivy, but it is capable of climbing up any support that it may happen to be near, even to the top of high trees. Being of rapid growth, it soon forms a large clump on the ground; the plant now under consideration was about 6ft. in height, and covered upwards of a rod of ground. To restrict it to these dimensions it became necessary from time to time to considerably reduce it, these reductions at times amounting to about one-third of the whole; the plant, therefore, has hitherto been freely handled without, so far as is known, having produced any ill-effects. I say so far as is known, because it is possible that it may have done so without the cause being suspected. The symptoms do not develop for some time after the influence has been exercised, rarely under 48 hours, being very similar to those of ordinary erysipelas they would be ascribed to an attack of that malady, and the cause producing them would not be suspected.

It is very probable that the plant may have a more poisonous influence at one season than another, and to this I am inclined to ascribe its effects in the present case, when six persons became poisoned by it at one time, two at least to a serious extent.

In the ordinary course of routine garden operations, any reduction or thinning necessary would have taken place earlier in the season, when the plant, which is deciduous, was

at rest. It having been decided to open up the square by reducing the number of plants growing on it, the work was deferred, as a matter of convenience, till a later period, and was not carried out till the 22nd September, when the plant was taken up, and destroyed by burning. On this date the sap was in full motion, and the plant had pushed freely, and was covered with young foliage. As the weather was warm at the time for the season of the year, the exhalations given off were, no doubt, greater than they would have been with the plant in a less active condition. This probably may account for its very pernicious effects at this particular time.

As stated above, six persons were poisoned to a more or less extent. The first to exhibit the symptoms was the overseer, Connor. The third day after contact with the plant his face became much swollen, but not such an extent as to prevent his continuing his occupation. The swelling gradually subsided, and he recovered in a few days.

The second man, Walsh, did not complain till the eighth day, when the face was swollen to such an extent that he could only see with difficulty. The arms and neck were covered with red blotches, and he had to leave his work and seek medical advice. The swelling continued for some time with formation of watery blisters about the wrists. By the eleventh day the symptoms had considerably abated, swelling going down, and skin peeling off the arms. He resumed work on the fourteenth day, having been laid up six. By this time the symptoms had subsided, with the exception of a dizziness of sight, which, though abating, still continues.

He states that the first symptoms he felt was about the third day. The arms commenced to feel stiff, and the head became sore to the touch, succeeded by an intolerable itching and profuse perspiration, which were followed by the swelling of the face and eruptions on the neck and arms.

About the same time, the eighth day, two of the men attached to the garden gang were exempted from work, their faces being swollen and systems generally affected. The case of one of the two assumed a serious aspect by the tenth day, when he was carried to the hospital, and was at first, I believe, considered in a somewhat critical condition. At the time of his admission the face was very much swollen, and fever symptoms high. Later, the chest and abdomen became completely covered by red inflamed blotches. From this time the symptoms began to abate, and on the ninth day from admission he was allowed to leave his bed for the first time, but still remains an inmate of the institution.

The other two cases were not of a severe character; in both, the arms only were affected. These became very irritable,

and broke out in red blotches and pustles, which, however, soon subsided.

It is worthy of remark that the hands, which, of course, would come into direct contact with the plant during the process of the work, did not appear to be affected in any way.

I have gone fully into the details of the case, as it is one of some interest, and one of rare occurrence out of North America, where the plant is indigenous; indeed, I am not aware of any similar case having occurred, more especially in the colonies. Therefore, as the facts connected with it are so clear, it is desirable that it should be placed on record.

I was present during the whole of the time occupied in taking up and burning the plant, passing to and fro between the plant and the fire, frequently handling portions of it as the work proceeded, without feeling its poisonous properties in any way, and at different times during the season I have handled it with impunity, especially in the autumn, when the falling leaves assume tints more effective than those of the Virginian creeper. At this season I have gathered the leaves by the handful without at any time being affected by it.

I need only add that if any of the medical men who may have attended the patients professionally will add their testimony, the case will be made more conclusive and interesting.

HISTORY OF AUSTRALIAN GEOGRAPHY, II—TASMANIA AND NEW ZEALAND ON THE DAUPHIN AND OTHER MS. MAPS.

By J. R. McClymont, M.A., Edin.

[The first of these papers appeared in the volume for 1885, p. 407, and should have been described "History of Australian Geography, I.—Edel's Land, De Witt's Land, and Carpentaria."]

On a recent occasion, when I had the honour of addressing this Society on the Portuguese Discovery of Australia, I anticipated the composition of this paper by stating that, in my opinion, no satisfactory explanation of the south-eastern portion of the Dauphin map (Add. MS. 5. 413. Brit. Museum) had been given. Mr. Major and Mr. Petherick have advanced conflicting opinions—a fact which may, perhaps, excuse my temerity in differing from so highly reputed an authority as theirs.

Mr. Major conjectures from the extreme length of the eastern coast line of Jave la Grande "that 'Baye Neufve'

represents Bass's Straits; that 'Gouffre' is Oyster Bay in Tasmania; and that the survey really ceased at the south of that island." Further, that the islands in the extreme east of his extract from the Dauphin map represent New Zealand. —*Early Voyages to Terra Australis*, Introduction, lviii.

Mr. Petherick's view is this:—"There is," he says, "at the north a 'grant baye' in the position of, and shaped like, the Gulf of Carpentaria. The Great Barrier Reef is also marked, and so are the mouths of the rivers on the coast of Queensland; further south, C. dlise, near what is intended for Great Sandy Island; then the coast-line, which I take to be that of New Zealand (being in the same latitude) trends south-east to a gulf and a 'R. longue,' with numerous islets (the Gulf of Hauraki); then eastward to a 'C. Fremose,' fair or beautiful cape (the East Cape of New Zealand); then south-west." *Mel. Rev.*, ix, 257. Again, after speaking more particularly of the map of Desliens, Mr. Petherick proceeds to say:—"Other MS. maps of the same period or earlier give the coast-line to the southern extremity of the Middle Island (of New Zealand), Cook's Straits being shown as a 'gulf.'" *Mel. Rev.*, viii, 376.

The difficulty lies in the identification of that portion of the coast-line extending from 'Baye Neufve' to 'C. de Fremose.' Mr. Major's explanation makes it identical with the North Coast of Tasmania or some part of that coast, Mr. Petherick's with the North Coast of New Zealand from Hauraki Gulf to the East Cape. If we accept Mr. Major's rendering, the draughtsman has made the north Tasmanian Coast 14deg. long from east to west instead of $3\frac{1}{4}$deg.; if Mr. Petherick's, he has made the space between Hauraki Gulf and East Cape 14deg. instead of 3deg.

A reference to other coasts of Jave la Grande, about which there is no dispute, and a deduction therefrom as to the reliance to be placed upon the accuracy of this map in respect of linear measurements[1] will assist us to determine the tenability of these hypotheses. I refer now, not to the geographical position of given points, as fixed by their latitude and longitude, but to the "stretch" east and west, or north and south, of coasts which extend in either of those directions.

Take, for instance, the west Coast of Jave la Grande from 'Baye Bassa,' which will be admitted to correspond roughly in position with our Cape Londonderry, to the southern limit of definite outline, regarded as approximate to our Cape Leeuwin. The actual difference between these points is $20\frac{1}{2}$deg.; the Dauphin map makes it 22deg. It is unfortunate that no similar terminal points, admitted by all authorities to

1 Mr. Major appears not to have observed the scale of latitude on this map.

be such, can be chosen on the east side of the map. Let us, however, take the points C. de Fremose and the extreme south point of definite outline on the same side of the map, and let us assume for a moment with Mr. Petherick that these represent the East Cape of New Zealand and the southern extremity of the Middle Island. On a modern map that coast extends for 9deg.; on the Dauphin map for 10deg.; and Mr. Petherick would have us believe that this singular agreement between ancient and modern geographers is nullified by the enormous error of 11deg. in the total distance of 3deg. from Hauraki Gulf to East Cape. I think it will be admitted at least that analogy does not support either of these hypotheses.

To aid us to a conclusion, I will assume that the indented line from 'Baye Neufve' to 'C. de Fremose' does not correspond with any actual coast-line. This assumption cannot be rated as unwarrantable when regard is had to certain other portions of the map. On the north side, Java, Sumbava, Flores, and a multitude of other islands are brought into close proximity or actually joined to Jave la Grande by means of lines which we know to have no real existence. They are so united to Australia in obedience to a pre-conceived theory of the unbroken continuity of all austral land. Similarly, on the south, the coasts are prolonged far beyond their actual limits. If the assumption of such another theoretical line in the part of the map under consideration will explain all discrepancies not otherwise explicable, except by hypotheses which do violence to the unity of the map, such an assumption is, I hold, worthy of serious attention. What do we find, then, if the line in question be left out? First, that the east coast of Jave la Grande now terminates in about 44deg. S., and that the last three or four degrees of its outline bear a resemblance to the east and south-east coasts of Tasmania, with the islands adjacent, almost as great as that borne by Tasman's map (1644), and greater than that borne by the chart of Furneaux (1773). Secondly, that the coast-line from 'C. de Fremose' to the southern limit of definite outline on the same side of the map corresponds in length with the east coasts of New Zealand from East Cape to the south of Stewart's Island. There is a great error in the latitude, but, as Mr. Major reminds us, "for the Portuguese this was the remotest point for investigation, and, consequently, the least likely to be definite." The errors in longitude, which Mr. Petherick would explain by a reference to the supposed narrowness of the Pacific Ocean, are in reality less than those perpetrated on the other coasts of Jave la Grande, and amount to about 8deg. at the southern, and 5deg. at the

northern, part of this coast-line. Thirdly, the relation of the islands named "Ysles de Magna" and "ye de Saill" to the remainder of the map is now explained. Let the coast-line from 'C. de Fremose' southwards be moved into its true position, and the islands in question will correspond roughly with the peninsula from Auckland to the North Cape.

The name 'Fremose,' fair or beautiful, as applied to the East Cape, may have a special significance. Voyagers well know the difference between the rough water south of that cape and the calm water of the Bay of Plenty.

A legend on Mercator's map (1569), to the effect that the Cape of Terra Australis lay in 42deg. S.,[2] appears to confirm our conclusion as to the south terminal point of the eastern coast-line of Jave la Grande, exclusive of the south-eastern extension, for it is much more probable that the latitude of the first or last seen point of the new continent would be thus noted and commemorated than that of any intermediate one.

To sum up, I submit that the assumption of the theoretical character of the line from 'Baye Neufve' to 'C. de Fremose' is justified by the analogy of other such lines on the same map, and reconciles a greater number of discrepancies than any other assumption.

The outline map, which accompanies this paper was drawn by Mr. John McCance, F.R.A.S., to whom I gratefully acknowledge my obligation. The thick outline is that of the modern maps, and represents so much of Australia as was known to certain French map-makers of the 16th century; the thin outline is that of those map-makers, and is added for the purpose of comparison. The whole may be regarded as a key to the views expressed in this paper.

2 "Hîc in latitudine 42gr.; distancia 450 leucarum a capite Bonæ Spei, et 600 a promontorio S. Augustini inventum est promontorium Terræ australis, ut annotavit Martinus Fernandus Denciso in sua Summa Geographia."

Proceedings of the Royal Society of Tasmania. 1886.

OF THE TIN ORE DEPOSITS OF MOUNT BISCHOFF, TASMANIA.

By Baron Von Groddeck, Chief Mining Councillor of the Hartz Mining Districts, and Director of the Royal Prussian Academy of Mines at Clausthal, Germany.

(Translated by Edgar Wolfhagen, M.B., Hobart, from the Special Imprint of the "Magazine of the Geological Society," 1886.*)

By the highly interesting description which M. Schroeder has given of the topaz deposits in the Schueckenstein and its surroundings, my attention was again drawn to the collection of specimens of minerals from Mount Bischoff, Tasmania, in the possession of the Royal Academy for Mineralogy in Clausthal. This collection has previously afforded me an opportunity for making a communication about a porphyritic topaz rock and about a peculiar topaz tourmaline deposit in the Tasmanian tin district.

According to M. Schroeder, the well-known topaz rock of the Schueckenstein (to which I have already referred in my description of the Tasmanian porphyritic topaz rock as an analogous formation) appears in a narrow topaz-bearing zone, "which extends almost at right angles to the limit of granite at the Laubach, and runs in an east-north-easterly direction across the Schueckenstein to the granite zone. It belongs to the outer zone of contact of the latter, or to its immediate neighbourhood."

M. Schroeder has shown conclusively that within this zone a transformation of the quartz-porphyry and tourmaline slate into topaz has taken place. He remarks that the topaz, thus transformed from quartz-porphyry, has a general resemblance to the Tasmanian topaz-rock described by me. The calcite, however, contained in the Tasmanian specimens is absent in the former, but it contains a certain amount of tourmaline. This difference in the accessory constituents does not seem to me to be of any great importance.

On account of the structure of the porphyric topaz rock described by me, which exactly resembles that of quaith-

* *The Mercury*, Hobart, Tuesday morning, Sept. 8th, 1885, contains a report of a meeting of the Royal Society of Tasmania, at which my work was discussed. To doubts which have been expressed as to the locality where the specimens which I examined were found, I must reply that Mr. Albert Wagenknecht is my guarantee. He unpacked the cases, which he had brought from Australia, in my presence, and mentioned the localities where the specimens were found. The specimens are, at any rate, from Australia; very minute particulars, as to where they were found, are, for obvious reasons, not attached to them. It may be that the label, "Mount Bischoff," indicates the whole tin district of Tasmania (Waratah and Penguin mining district), in which this mountain is prominent on account of its rich mineral deposits.

porphyry in every respect, there can be no doubt that the Tasmanian rocks are also topaz-quartz-porphyry, more especially after M. Schroeder has made us acquainted with the topaz-quartz-porphyry of the Schueckenstein.

It appears, therefore, as if in the tin district of Tasmania (as in the Schueckenstein in the south-west of Saxony) a transformation of the rocks with topaz had taken place during the formation of the tin deposits. This is a previously unknown geological process of the highest interest, since it introduces new views as to the origin of the tin deposits. This process is probably not so isolated as would at present appear. The discovery made by M. Schroeder is the more interesting, as many pseudo-morphoses from topaz to other minerals are known, but no change of another mineral into topaz.

On the Schueckenstein the transformation with topaz occurs, according to M. Schroeder, by the topaz replacing both tourmaline and feldspar. Such pseudo-morphoses are not directly traceable in the Tasmanian specimens now before me; but in them pseudo-morphoses from quartz to topaz are evident. This must aid considerably in increasing our knowledge of the appearance of topaz. In a block of about 5 c.m. the inner portion consists of transparent crystalline quartz, with an admixture of dark grains of tin. Towards the outer portion of this block many irregularly-disposed columns or cryssals are seen. Only a few of these show the ordinary structure and form (∞ R., R. — R.) of ordinary quartz. The majority have a rough surface, are rounded at the angles, and are coloured pale-white. On breaking these crystals, as a rule, a perfectly transparent nucleus of quartz is seen, showing an uneven fracture. This nucleus is surrounded by a pale-white mass, which, on examination with a lens, appears partly homogeneous, partly delicately striated.

This mass is topaz, as is shown by an analysis made by Mr. Sommerlad. The material for this was not to be obtained absolutely pure, on acconnt of the small quantity at our disposal, and of the firm concretion of the topaz with quartz and microscopic grains of tin.

The analysis gave—

$Si. 0^2$	56·32
$Al.^2 0^3$	35·91
Fl.	10·68
Ca. 0	0·03
$Sn. 0^3$	2·42†
	105·36

†As during the principal analysis the exact amount of tin present was not ascertained, other specimens, as pure as possible, were selected for another analysis. These seem to have contained more microscopic tin grains than the first specimens.

By calculation is obtained—

29·93	$Al.^2 0^3_{11}$
17·46	$Si. 0^2$
3·18	Al.
11·02	Fl.
1·62	$Si. 0^2$
63·21	Topaz.
35·39	Quartz.
2·42	Tin.
0·03	Ca. 0.
101·05	Total.
—0·34	Fl.
= 100·71	

Just as the fine white topaz from Mount Bischoff, previously examined (c.f.r. this Journal, 1884, page 647), this topaz also contains some lime. According to Sandberger, its presence is caused by an incipient transformation from topaz to prosopit.

The topaz does not appear simply as a crust surrounding the quartz crystals, but as a pseudo-morphosis from them. In proof of this, the circumstance that the thickness of the topaz crust is always in inverse proportion to the diameter of the quartz nucleus (the entire crystals being of an even diameter of from 2-3 mm.) must be considered. In some crystals the topaz has entirely replaced the quartz; in others there appears a nucleus which, on breaking, is seen to be a very minute point. Between crystals of this form, and others only slightly surrounded by topaz, or wholly free from it, all transition stages are represented. It is remarkable that quartz crystals, partially transformed into topaz, have lost their distinct outline and smooth surface.

On transverse fracture of crystals containing larger quartz nuclei, it is seen that the topaz has advanced in a very irregular manner from without inwards. The crusts of topaz are not of uniform thickness; they protrude into the quartz in an angular manner. This is particularly well seen in thinly ground sections. The line of demarcation between topaz and quartz is quite irregular. The former contains, as is specially well seen under the microscope, small grains of quartz. Minute crystals of topaz protrude into the clear quartz in the form of needles, fibres, and bundles of fibres, or even lie, apparently isolated, in among the quartz. The quartz contains innumerable, irregularly distributed vacuoles, partly of an irregular, partly of an angular form. (Negative crystals).

The topaz is to be distinguished from the quartz by ordi-

nary light, by its dull colouration, and very finely granular or radiating fibrillar structure. This structure is still more beautifully seen by polarised light. The granular and fibrillar portions interlace in an irregular manner; the latter show very markedly an eccentric librillar structure, radiating from many points. This structure reminds one of that of sphaerulites. The appearance, on the whole, may be compared to that of ice crystals on a window, an appearance quite unusual for topaz.

Between the aggregate of topaz are seen isolated, generally small brown tin crystals, in width about 0·06 mm.; in length, 0·13 mm., rarely larger ones of a width of 0·04 mm. These crystals show twin formation and a zonular structure, this latter structure being evident on account of difference in colour.

To judge from one specimen among the collection, the pseudo morphoses which have been described appear to have taken place in clefts of a breccia of tourmalin, quarzit, and slate, of which several pieces are to hand.

The previously mentioned analogy between the formations of the Schueckenstein and its surroundings and these Tasmanian formations is considerably strengthened by the fact that this breccia, on the whole, corresponds to that in the Saxon formations described by M. Schroeder.

The specimens before me contain angular, chiefly flat, fragments of stone, about $2\frac{1}{2}$ c.m. in size. These consist of alternate layers of a light grey and brown, or greyish-green substance, of a thickness from that of paper to one of 5 mm. These layers are either straight or wavy. The light-grey strata show a finely granular, crystalline, shiny fracture; the more darkly-coloured strata, a more dense and duller fracture. From microscopic examination it is evident that these slate-like specimens contain only quartz and tourmaline; in the lighter strata there is more quartz, in the darker more tourmaline.

It is known that quartz appears sometimes in the form of a more or less finely granular aggregation. On treatment with Hydrofluoric acid only tourmaline remains, the quartz being dissolved. The tourmaline forms very minute needles, 0,02 m.m. broad, 0·13 m.m. long. These needles unite to form fibrillar or felt-like masses, or appear isolated in the quartz. Thoroughly formed or hemi-morphous crystals I have not been able to find. Not uncommonly, however, are seen among the needle-like and fibrillar forms characteristic, roundly triangular, transverse sections of tourmaline crystals.

By ordinary light the colour of tourmaline is chiefly brown, more rarely green, and most rarely blue. The pleochroism is very strong. A structure in which there is a difference in

colour between the nucleus and the crust is very common. In addition, the tourmaline is characterised by its insolubility in hydrofluoric acid and its intense reaction with beracic acid.

The binding material of the breccia consists of a crystalline and granular mixture of quartz and tourmaline. The quartz is concentrated in more or less extensive round patches of a white colour, and is finely granular. Here and there are also found isolated larger quartz crystals. The binding material contains many minute hollow spaces, the walls of which are covered by minute quartz crystals and hair-like tourmaline needles.

Attempts to find topaz in this breccia were productive of no definite result.

It remains undecided, therefore, whether the Tasmanian tourmaline-quarzit slate has undergone a transformation into topaz, as is the case in that of Saxony.

THE TROCHIDÆ AND OTHER GENERA OF MOLLUSCA FROM TASMANIA, WITH THEIR SYNONYMS.

Part I.

By John Brazier, F.L.S., C.M.Z.S., C.M. Royal Soc., Tasmania.

Having paid considerable attention to the Molluscan Fauna of Tasmania during the last 30 years, it is my intention, from time to time, to give to the Royal Society of Tasmania the benefit of my investigations. I now send my first paper on *Trochidæ* and other Genera of Mollusca :—

Part 1.—The coast of Tasmania is rich in *Trochidæ*. The Rev. Tenison-Woods appears to have done some good work in the recent species in his Census in the Proc. of the Society, 1877, published 1878. Some of the species are incorrectly identified, for instance, he quotes *Thalotia picta*, Wood. The *Thalotia* so quoted is a very narrow form of *Trochus* (*Thalotia*) *conicus*, Gray. The *Thalotia picta* of Tenison-Woods is the *Phasianella elegans* of Lamarck. Kiener, in his Coquilles Vivantes, having charge of Lamarck's collection, found out that it belonged to *Trochidæ*, and called it *Trochus elegans*. There being already in the genus Trochus, an *elegans*, Dr. Fischer named it *Trochus Lesueuri*. The *Thalotia mariæ*, Tenison-Woods, is the *Trochus pulcherrimus*, Gray, well

figured by Wood in 1828, and by Dr. Phillippi in 1845. Then we have the grand *Zizyphinus*, always been quoted by Tasmanian concologists as *Zizyphinus armillatus*, Woods. The Tasmanian shell is quite distinct from *Trochus armillatus*, of Wood's Index Test, 1828. The Tasmanian species is the *Trochus* (*Zizyphinus*) *Meyeri*, Philippi, described in 1848. The other little *Trochus* quoted as *Trochus* (*Clanculus*) *rubens*, A. Adams, is the *Trochus* (*Clanculus*) *Dunkeri* of Koch described in 1842. A. Adams never described a *Clanculus* as *rubens*. *Trochus Australis*, Tenison-Woods, is the *Trochus Adelaidæ*, Phillippi, described about 1846 or 1855. The *Trochus conicus*, Gray, is the *Trochus pictus*, Wood, and *Monodonta turrita*. Menke is *Trochus Lehmanni*, Kiener, and also of Homb et Jacq it is the *Thalotia picta*, Tenison-Woods. The other species are enumerated in another part of my paper, and I need not mention them here. I am informed by the energetic curator, Mr. A. Morton, that the shells in the Tasmanian Museum from Tasmania are simply labelled "Tasmania," a very wide term. I presume that Mr. Legrand had the same idea that the late Mr. Cuming had to destroy the correct locality, necessitating hunting the works up in which it was described before you could find the correct and exact locality or the information required, a rather roundabout way to get at the desired information. I am under much obligation, with many thanks, to Mr. W. F. Petterd, of Launceston; Lieut. C. E. Beddome, of Hobart; Rev. H. D. Atkinson, of Circular Head; Mr. A. Simson, George Town, North Tasmania; the late Mr. J. F. Bailey, of Melbourne; Mr. J. H. Gatliff, Melbourne; Mr. W. T. Bednall and Professor Tate, of South Australia, for exact localities and numerous specimens sent for determination.

1. Trochus (Cantharidus) Lesueuri. Fischer, sp.

1822 *Phasianella elegans*, Lam, Anim. sans Vert, vol. 7, p. 53 No. 4.

1843 *Phasianella elegans*, Lam 2nd edition (Deshayes), vol. 9, p. 243.

* *Trochus elegans*, Kiener, Species Genus Trochus Coq. Vivantes, pl. 45, fig. 2 (non *Trochus elegans*, Gmelin).

1843 *Trochus Lehmanni*, Menke, Moll. Novæ Hollandiæ, p. 18, No. 70 (non *Trochus Lehmanni*, Kiener).

1845 *Trochus Lehmanni*, Menke, Phillippi in Abbild Besch neuer Conch., vol. 2, heft. 2, p. 37, pl. 7 (Trochus), fig. 2 (non *Trochus Lehmanni*, Kiener).

* The date of publication of the first portion of Kiener's Genus Trochus in the Coquilles Vivantes I have not been able to trace out. That continued by Dr. P. Fischer was published in 1880.

1845 *Trochus Lehmanni*, Menke, Catlow and Reeve, Conchologists' Nomenclator, p. 217, No. 75.

* 1849 *Trochus pictus*, Phillippi in Conch. Cab., 2nd edition, p. 139, No. 166, pl. 23, fig. 18-19 (non *Trochus pictus*, Wood).

1851 *Thalotia Lehmanni*, A. Adams, Proc. Zool. Soc., p. 172, No. 4.

1854 *Thalotia Lehmanni*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.

1859 *Gibbula* (*Forskalia*) *elegans*, Chenu, Manuel de Conchyliologie, tome 1, p. 362, fig. 2,690.

1865 *Thalotia picta*, Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 179, No. 150 (non *Trochus pictus*, Wood).

1873 *Thalotia Lehmanni*, Paetel, Catalog der Conch-Sammlung, p. 73.

1877 *Thalotia picta*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41 (non *Trochus pictus*, Wood).

1880 *Trochus Lesueuri*, Fischer in Kiener, Coq. Vivantes, pp. 129-420.

Shell imperforate, thick-conoidal or conical, acute at the apex, ornamented with elegant flames, alternately brown and white; whorls 7, a little convex, swollen and carinated at the ower part; the first 2 whorls, nearly always decorticated, are pink or reddish; the others have numerous spiral striæ (about 10 on the penultimate whorl), articulated or spotted with red, and brown or white longitudinal flames; last whorl flattened at the upper part, swollen in the middle and sometimes subcarinated; base ornamented with numerous concentric liaræ; aperture oval; peristome thickened, bordered with red or pink at the upper part; the red colouring also extends outside of the columellar margin; interior of the aperture lirate, nacreous. Height 16, width 12 millimetres. Others measure in height 12, and width 9 millimetres.

This species was described first by Lamarck as *Phasianella elegans*. Kiener, in his Coquilles Vivantes placed it in the genus *Trochus* under the name of *Trochus elegans*, the name of *elegans* already being used by Gmelin for a species from New Zealand, and which is a synonym of *Trochus purpuratus*, Martyn. Lamarck's species is also the *Trochus Lehmanni*, Menke; also the *Trochus pictus*, Phillippi-non-Wood. My late lamented friend, Mr. Angas and the Rev. Tenison-Woods quotes it as *Thalotia picta*, Wood. The *Trochus* (*Thalotia*) *pictus* of Wood is the *Trochus conicus*, Gray.

The title page of the Genus Trochus, with the date of publication in the Conchylien Cabinet, is wanting in the volume contained in the Australian Museum Library. In an old book catalogue and the Zeitschrift fur Malakazoologie, I have traced the publication of the Monograph, by Dr. Philippi, from 1846, 1855.

Mr. A. Adams, in his list of TROCHIDÆ, Proc. Zool. Soc, 1851, p. 172, No. 4, had an idea that (?) *Phasianella elegans*, Lam., was the same as *Trochus Lehmanni*, Menke. In that view Adams was quite correct, but he was doubtful of it being a *Phasianella*. Dr. Fischer points out in Kiener, p. 129, that the figure of *Trochus pictus*, Wood, is a very doubtful one; a new specific name being required for Lamarck's species, he names it *Trochus Lesueuri*.

Hab.—Coast of Australia (*Peron and Lesueur*), Se, Vincent's Gulf, South Australia (*G. F. Angas*); Cape Richt. King George's Sound (*Brazier*); Tasmania (*Tenison-Woods, W. F. Petterd, C. E. Beddome*); South Australia (*Professor Tate, W. T. Bednall*).

2. TROCHUS (CANTHARDIUS) PULCHERRIMUS. Gray, sp.

1828 *Trochus pulcherrimus*, Gray; Wood, Index Test. Supplement, p. 18, pl. 6, fig. 45. *Monodonta pulcherrima*, Gray, p. 44.

1843 *Trochus Preissii*, Menke, Moll. Nov. Hollandiæ, p. 17, No. 69.

1845 *Trochus pulcherrimus*, Wood, Phillippi Abbild neuer Conch., vol. 2, heft. 2. Trochus, p. 37, pl. 7. fig. 1.

1849 *Trochus pulcherrimus*, Wood; Phillippi in Martini and Chem, 2nd edition (Kuster), p. 132, No. 153, pl. 23, fig. 4.

1850 *Trochus pulcherrimus*, Wood; Jay's, Catalogue of Shells, 4th edition, p. 306, No. 7,440.

1851 *Thalotia pulcherrima*, Wood; A. Adams, Proc. Zool. Soc., p. 172, No. 2.

1854 *Thalotia pulcherrima*, Wood; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.

1856 *Trochus pulcherrimus*, Gray; Wood, Index Test. (Hanley's Edition), p. 221, pl. 6, fig. 5, very bad.

1865 *Thalotia pulcherrima*, Wood; Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 179, No. 151.

1873 *Thalotia pulcherrima*, Wood; Paetel, Catalog der Conch. Sammlung, pp. 11-73.

1877 *Thalotia mariæ*, Tenison-Woods, Proc. Roy. Soc., Victoria, p. 58.

1877 *Thalotia mariæ*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41.

1880 *Trochus pulcherrimus*, Wood; Fischer in Kiener, Coq. Vivantes, p. 137, pl. 46, fig. 4-4a.

Shell imperforate, conoid, elongated, rather thick; whorls $6\frac{1}{2}$, embryonic whorls smooth, purple-brown; the next shiningn, a little convex with transverse girdles or belts nearly flat, 3 to 5 in number, and of in equal width; girdles ornamented with subgranular spots purple or brown, obliquely articulated with white, nearly always in the direction of the spots, different on the upper and lower girdles or belts; last whorl rounded or subcarinate; upper part ornamented with 4 broad girdles or belts; base with 4-7 belts divided by a shallow groove; aperture rhomboidal, peristome bordered with intense reddish pink; interior white, more or less shaded with greenish, and vividly iridescent; columellar scarcely arcuate, simple, not denticulated. Height 17, width 11-12 millimetres.

Hab.—Swan River, Western Australia (*Preiss*); Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Cape Riche, King George's Sound (*Brazier*); Holdfast and Aldinga Bays, South Australia (*G. F. Angas*); South Australia (*Professor Tate, W. T. Bednall*); Northern Tasmania (*Tenison-Woods, W. F. Petterd*).

3. Trochus (Thalotia) conicus, Gray, sp.

1827 *Monodonta conica*, Gray in Captain King's Survey of Australia. Appendix vol. 2, p. 479, No. 28.

1828 *Trochus pictus*, Wood, Index Testaceologious. Supplement, p. 17, pl. 5 (Trochus), fig. 28.

1843 *Monodonta turrita*, Menke, Moll. Novæ Hollandiæ, p. 15, No. 57.

Trochus Lehmanni, Kiener, Coq. Vivantes species, Genus Trochus, pl. 46, fig. 2 (non *Trochus Lehmanni*, Menke).

1849 *Trochus conicus*, Phillippi, Conch. Cab. 2nd edition, p. 172, No. 150, pl. 23, fig. 1.

1849 *Trochus turritus* (Monodonta), Menke = *conicus*, Gray. Phillippi in Conch. Cabinet, 2nd edition, p. 372, Index.

1851 *Thalotia picta*, A. Adams, Proc. Zool. Soc., p. 172, No. 1.

1854 *Thalotia conica*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420, plate 48, fig. 1.

1854 *Thalotia picta*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.

1854 *Trochus Lehmanni*, Hombron and Jacquinot, Voyage au Pole-Sud, Zoologie, vol. 5, p. 54; atlas plates Mollusca, pl. 14, figs. 7-8 (non *Trochus Lehmanni*, Menke).

1856 *Trochus pictus*, Gray; Wood, Index Test Supplement. (Hanley's Edition), p. 220, Trochus plate 5, fig. 28.

1859 *Trochus (Thalotia) Lehmanni*, Chenu, Manual de Conch., tome 1, p. 359, fig. 2,659 (non *Trochus Lehmanni*, Menke).

1865 *Thalotia conica*, Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 179, No. 148.

1865 *Thalotia picta*, Angas (as of Wood). Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 179, No. 150.

1873 *Thalotia conica* (Sowerby ! !). Paetel, Catalog der Conch. Sammlung, p. 73.

1873 *Thalotia picta*, Wood; Paetel, Catalog der Conch., Samm., p. 73.

1873 *Zizyphinus conicus*, Gray; Paetel, Catalog., p. 74.

1877 *Thalotia picta*, Tenison-Wood's (as of Wood) Papers and Proc. Royal Soc., Tasmania, p. 41.

1880 *Trochus conicus*, Fischer in Kiener, Coq. Vivantes, p. 135.

1881 *Monodonta turrita*, Menke = *Thalotia conica*, Tate, Proc. Linn. Society, N.S.W., vol. 6, p. 394.

1883 *Trochus (Thalotia) conicus*, Gray; Tryon, Structural and Systematic Conchology, vol. 2, p. 312, pl. 81, fig. 52, bad.

Shell imperforate, conical, acute at the apex; whorls 6-7, a little convex, the embryonic whorls rosy or reddish, the lower whorls having 5-6 transverse granulose liræ, and obsolete brownish spots forming longitudinal narrow bands; last whorl rounded or obtusely carinated, base convex, encircled with 5-6 granulose liræ; aperture rhomboidal; columellar arched, having numerous corrugations or tuberculosus ridges, truncated at the base; basal margin plicated inside, as well as the right margin, which is thickened, interior of the aperture greenish or vividly iridescent. Height 21-22, width 15-16 millimetres.

Hab.—New Holland (*Captain Phillip P. King*); King's Island, Bass Strait (*Peron and Lesueur*); Western Australia (*Dr. Preiss*); New Holland (*Hombron and Jacquinot*); St. Vincent's Gulf, South Australia (*G. F. Angas*); Bass Straits and North-east Tasmania (*Tenison-Woods*).

4. Trochus (Diloma) odontis. Gray, sp.

1828 *Trochus odontis*, Gray; Wood, Index Test. Supplement, p. 37, pl. 6. Trochus, fig. 37. *Monodonta Odontis*, Gray, l.c., p. 44.

1849 *Trochus odontis*, Wood; Phillippi in Conch. Cab., 2nd edition, p. 144, No. 174, pl. 24, fig. 7.

1851 *Chlorostoma odontis*, A. Adams, Proc. Zool. Society, p. 182, No. 22.

1854 *Diloma odontis*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.

1856 *Trochus odontis*, Gray; Hanley's Edition of Wood Index Test. Supplement, p. 221, pl. 6, fig. 37.

1865 *Diloma odontis*, Angas, Molluscan Fauna of the Province of South Australia. Proc. Zool. Soc., p. 182, No, 173.

1873 *Gibbula odontis*, Paetel, Catalog der Conch.-Sammlung, p. 75.

1877 *Trochus* (*diloma*) *odontis*, Tenison-Woods, Papers and Proc. Royal Society of Tasmania, p. 43.

1880 *Trochus odontis*, Wood; Fischer in Kiener Coq. Vivantes. Trochus, p. 313, No. 180, pl. 99, fig. 1

This well-known species cannot be confounded with any other *Diloma* found either in New Zealand, Tasmania, or Australia. It is of a very smooth, dark-blue colour, with fine zig-zag lines and yellow spots; interior of the aperture iridescent-green, pea-green round the columella margin. The genus *Diloma* was founded by Dr. Phillippi in 1845 to receive Conoidal shells, smooth, not umbilicated; whorls rather few, convex; aperture subrotund; columellar lip excavated in the middle and expanded over the umbilical region, produced laterally to join the outer lip; outer lip thin, unarmed.

Hab.—"———?" (*J. F. Gray*); New Holland (*Philippi, Paetel*); Port Phillip, on the rocks at low water (*J. B. Jukes*); Cape of Good Hope??? (*Hanley*); Port Western, Victoria (*Quoy and Gaimard*); Port Sorell, North Tasmania (*C. E. Beddome*); Wallaroo, South Australia (*G. T. Rossiter*, 1861); rocks at low water St Vincent's Gulf, South Australia (*Professor Tate*); St. Kilda Beach, Hobson's Bay (*J. H. Gatliff*); Hobson's Bay, Victoria (*G. T. Rossiter*, 1862); Brighton, Victoria (*J. F. Bailey*); Blackmans Bay, Tasman's Peninsula, Port Davey, Swansea, Tamar Heads, Tasmania (*W. F. Petterd*); Patriarchs, East Coast of Flinders Island, Bass Straits (*Mr. A. Simson*).

5. Trochus (Diloma) Adelaidæ. Philippi, sp.

1849 *Trochus Adelaidæ*, Phillippi in Conch. Cab., 2nd edition, p. 140, No. 168, pl. 24, fig. 1.

1851 *Gibbula Adelaidæ*, A. Adams, Proc. Zool. Soc., p. 186, No. 22.

1854 *Oxystele Adelaidæ*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 427.

1873 *Oxystele Adelaidæ*, Phil; Paetel, Catalog der Conch. Sammlung, p. 74.

1876 *Diloma australis*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 145.

1877 *Trochus* (*diloma*) *australis*, Tenison-Woods, Proc. Royal Soc., Tasmania, p. 43.

1880 *Trochus Adelaidæ*, Phillippi; Fischer in Kiener Coq. Vivantes. Genus Trochus, p. 210

1884 *Diloma australis*, Tenison-Woods; Hutton, Proc. Linn. Soc., N.S.W., vol. 9, p. 368.

I have the original specimens of this species and many other forms collected by my father-in-law, Captain Thomas Rossiter, in 1841, the year that he saved Mr. John Eyre (now Sir John Eyre) from starvation, when on his ever memorable trip overland from Adelaide to King George's Sound Specimens of this I distributed some years ago under the name of *Trochus Adelaidæ*, Phil, they having been identified by the late Messrs. H. and A. Adams, but for some unknown reason the Rev. Tenison-Woods redescribes it as *Trochus australis*. I have seen it in collections named *Trochus odontis* variety, Gray. The *Trochus Adelaidæ* is spiraly sulcated and ornamented with pale yellow and numerous pale brown undulating lines, margin of the peristome tinged with green. This species has evidently been taken for the young of *Trochus* (*Trocochochlea*) *concameratus*, Gray, not *Trochocochlea striolatus*, Wood!! as quoted by the Rev. Tenison-Woods. Professor Hutton described another *Diloma*, in 1878, as *Trochocochlea mimetica* from Auckland, New Zealand. It was first described by Dr. Phillippi, in 1848, as *Trochus* (*Phorcus*) *crinitus*, said to have been found in New Holland, an error for certain. I have a specimen of it, collected by Mr. G. T. Rossiter, at Nelson, New Zealand, in 1860. Hutton makes it a new sub-genus Latona of Monodonta. He says:—"Shell as in Diloma, but perforated." This character is of very little value to make a sub-genus of. I have handled hundreds of specimens of *Diloma odontis* and *Adelaidæ*, and find that specimens in both are perforated, as well as imperforate, and that the three species—*Diloma odontis*, Gray; *Adelaidæ*, Phillippi; *crinitus*, Phillippi = *mimetica*, Hutton—have the region of the columella tinged with bright pea-green, and the interior of the aperture bright iridescent green I found a splendid specimen of *Trochus Adelaidæ*, Phillippi, in a lot of *Trochus odontis*, collected by Mr. A. Simson, at Patriarchs, East Coast of Flinders Island, Bass Strait.

Hab.—Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Adelaide in New Holland (*Philippi*); St. Vincent's Gulf, South Australia, sent by Bednall some years ago as *Trochus odontis*? Wood; rocks at low tide Great Australian Bight (*Professor Tate*); Cape Riche, King George's Sound, S.W. Coast of Australia (*J. Brazier*); St. Vincent's Gulf, off the Semaphore in Largs Bay, South Australia (*W. T. Bednall*, 1865); Portland, Victoria (*J. H. Gatliff*); North Coast of Tasmania and Islands in Bass Straits (*W. F. Petterd*); Patriarchs, East Coast of Flinders Island, Bass Straits (*Mr A. Simson*).

6. Trochus (Zizyphinus) Meyeri, Philippi, sp.

1848 *Trochus Meyeri*, Phillippi, Zeitscher fur Malak,p.101.

1849 *Trochus Meyeri*, Phillippi in Conch. Cab., 2nd edition, p. 279, No. 362, pl. 41, fig. 4.

Trochus armillatus, Kiener, Coq. Vivantes Genre Trochus, pl. 17, fig. 2 (non *Trochus armillatus*, Wood).

1854 *Trochus levis*, Hombron et Jacquinot, Voyage au Pole Sud, vol. 5 Zoologie, p. 56; Atlas plates Mollusca, pl. 14, figs. 17-18.

1863 *Zizyphinus armillatus*, Reeve, Conch. Icon., pl. 3, fig. 19, very bad (non *Trochus armillatus*, Wood).

1865 *Zizyphinus armillatus*, Angas, Molluscan Fauna of the Province of South Australia. Proc. Zool. Soc., p. 180 (non *Trochus armillatus*, Wood).

1873 *Zizyphinus armillatus*, Paetel, Catalog der Conch.-Sammlung, p. 73 (non *Trochus armillatus*, Wood).

1873 *Zizyphinus Meyeri* (Dunker!!), Paetel, Catalog der Conch.-Sammlung, p. 74.

1877 *Zizyphinus armillatus*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41 (non *Trochus. armillatus*, Wood).

1880 *Trochus Meyeri*, Phillippi, Fischer in Kiener's Coq. Vivantes, p. 76, No. 10.

This beautiful Zizyphinus has always been called *armillatus*, Wood. If any naturalist will take a specimen and compare it with the *Trochus armillatus*, Wood, figured in the Supplement to the Index Testaceologicus, pl. 5, Trochus, fig. 5, 1828, he will at once see that the Tasmanian shell is quite distinct in being more conical, and with flatter whorls than Wood's shell. I append description from a Tasmanian example:—Shell imperforate, conical, yellowish, fawn or brown spotted, whorls 8 to 9 flat, ornamented with seven spiral rows of granulous liræ, separated by smooth

interstices ; last whorl carinated, scarcely convex at the base, ornamented with distinct brownish radiating flexuous markings,the granulous liræ concentric to the columellar axis, about ten in number, more granulous near the centre, interstices pinkish ; aperture rhomboidal ; umbilical region depressed. Alt., 33 ; breadth, 30 ; least breadth, 29 millimetres. Paetel in his Catalogue erroneously attributes this species to Dunker.

Hab.—King's Island, Bass Strait (*Peron and Leseurer*) ; Encounter and Guichen Bays, South Australia (*G. F. Angas*) ; New Holland (*Hombron and Jacquinot*) ; Australian Sea (*Paetel*) ; Tasmania (*Paetel*) ; Port Western, Victoria (*J. H. Gatliff*) ; Tasmania (*W. F. Petterd*).

7. Trochus (Clanculus) Dunkeri, Koch, sp.

1843 *Trochus (Monodonta) Dunkeri*, Koch, in Philippi. Abbild und Besch neuer Conch., vol. 1, heft 3, p. 6, pl. 2, fig. 5. Trochus.

1849 *Trochus Dunkeri*, Koch, Phillippi Conch. Cab., ed. 2, p. 237, No. 300, pl. 36, fig. 5.

1851 *Monodonta Dunkeri*, Koch; A. Adams, Proc. Zool. Soc., p. 174, No. 10.

1854 *Euchelus Dunkeri*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 419.

1865 *Clanculus rubens*, A. Adams; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 178, No. 144.

1873 *Clanculus Dunkeri*, Paetel, Catalog der Conchylien-Sammlung, p. 73.

1877 *Clanculus rubens*, A. Adams ; Tenison-Woods Papers and Proc. Royal Soc., Tasmania, p. 40.

1880 *Trochus Dunkeri*, Fischer in Kiener, Coq. Vivantes, p. 301, No. 171, pl. 96, fig. 2.

Shell imperforate, having a little hollow or depression at the place of the umbilicus, orbicularly conoid, sub-depressed, thick, whorls 5 ; the first whitish often eroded ; the last brownish or reddish, obliquely striated and ornamented with transverse or spiral granulose liræ, 3 on the penultimate whorl, last angular a little convex, ornamented with 4 granulus beaded liræ, separated by well-marked interstices ; base with 5-6 concentric granose liræ ; aperture oblique, rhomboidal, with plications far in the interior ; peristome thickened, plicated, denticulated at the upper part ; columellar oblique, ending with an acute and narrow tooth ; columellar callosity scarcely developed, plicated. Height, 8 ; width, 11 millimetres.

Some specimens are 9 long, breadth 12-13 millimetres.

Hab.—"——?" (*Koch*); Adelaide in New Holland (*Phillippi*); St. Vincent's Gulf, South Australia (*G. F. Angas*); Cape Riche, south-west coast of Australia (*J. Brazier*); Bass Strait (*Tenison-Woods*); Australia (*Paetel*).

Mr. Angas always returned this species named as *Clanculus rubens* of A. Adams. There was no such species as *Clanculus rubens* ever described by A. Adams. Mr. Angas was the first who published the name in Proceedings of the Zoological Society of London, 1865, p. 178.

The first record of its being described was by Koch, in 1843, as *Trochus* (*Monodonta*) *Dunkeri*. The specimen figured by Fischer in Kiener's Coquilles Vivantes was from specimens sent by Angas to Monsieur Crosse in Paris.

8. Diala lauta. A. Adams, sp.

1862 *Diala lauta*, A. Adams, Ann. Nat. Hist., vol. 10, 3rd series, p. 298, No. 5.

1865 *Diala lauta*, A. Adams; Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 173, No. 111.

1873 *Diala lauta*, A. Adams; Paetel, Catalog der Conch.-Sammlung, pp. 6-49.

1875 *Diala punctata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 147.

1875 *Diala lauta*, A. Adams; E. A. Smith, Proc. Zool. Soc., p. 538.

1877 *Diala punctata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 37.

I received specimens of *Diala lauta* from the Rev. Mr. Atkinson, labelled *Diala tessellata*, Tenison-Woods.

Hab.—Port Adelaide (*A. Adams*); St. Vincent's Gulf, often in shell sand at the head of Spencer's Gulf, South Australia, along with Truncatella and Bittium in vast numbers (*G. F. Angas*); D'Entrecasteaux Channel, South Tasmania (*Rev. H. D. Atkinson*).

9. Diala monile. A. Adams, sp.

1862 *Alaba monile*, A. Adams, Ann. Nat. Hist., vol. 10, 3rd series, p. 296, No. 17.

1865 *Alaba monile*, A. Adams; Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 173, No. 109.

1875 *Diala tessellata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 147.

1875 *Diala monile*, A. Adams; E. A. Smith, Proc. Zool. Soc., p. 538.

1877 *Diala tessellata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 37.

Hab.—Port Lincoln, South Australia (*W. Metcalfe, A. Adams*); Port Lincoln, in shell sand (*G. F. Angas*); Tasmania (*Tenison-Woods*); mouth of Crookhaven River, N.S.W., in shell sand (*J. Brazier*).

10. CERITHIUM (POTAMIDES) MONACHUS. Crosse and Fischer, sp.

1855 *Cerithium dubium*, Sowerby, Thes. Conch., vol. 2, p. 864, No. 62, pl. 181, fig. 120 (non *Cerithium dubium*. Sowerby Mineral Conchology, 1816).

1865 *Cerithium monachus*, Crosse and Fischer, Journal de Conchology, p. 347, pl. 3, figs. 17-18.

1865 *Potamides monachus*, Angas, Molluscan Fauna of South Australia. Proc. Zool. Soc., p. 171.

1865 *Cerithium dubium*, Sowerby; Reeve, Conch. Icon., pl. 12, sp. 78 a.b.

1877 *Cerithium dubium* (Reeve !!) Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 35.

1880 *Cerithium eludens*, Bayle, Journal de Conchology, vol. 27, 3rd series, p. 245, No. 9.

This species was described first by Mr. Sowerby, in 1855, as *Cerithium dubium* from Van Diemen's Land, now Tasmania. Crosse and Fischer described it again, in 1864, under the name of *Cerithium monachus* from specimens collected by Mr. Angas in South Australia. Monsieur Bale, in the French Journal de Conch., 1880, gives it a new specific name as *Cerithium eludens* to replace the one given by Sowerby, in 1855, Sowerby, in 1816, having used *dubium* for a fossil species, Bale not knowing that Crosse and Fischer had described it in 1864 as *Cerithium monachus*, therefore Bale's name must be placed amongst the synonyms. Tenison-Woods erroneously attributes this species to Reeve.

Hab.—Van Diemen's Land (*Sowerby*); Yorke's Peninsula, Adelaide Creek, South Australia; St. Kilda, near Melbourne (*G. F. Angas*); Tasmania (*Tenison-Woods*); Hobson's Bay, Victoria (*R. C. Rossiter*, 1861).

11. CASSIS SEMIGRANOSA. Lam., sp.

1822 *Cassis semigranosa*, Lam, Hist. Anim sans Vert, tome 7, p. 228, No. 23.

1824 *Cassis semigranosa*, Lam; Dubois', Epitome of Lamarck's Arrangement of Testacea, p. 253.

1828 *Buccinum semigranosum*, Wood, Index Test. Supplement, p. 11, pl. 4, fig. 2.

Cassis semigranosa, Lam; Kiener, Icon. Cq. Viv., p. 36, No. 23, pl. 14, fig. 29.

1844 *Cassis semigranosa*, Lam, Anim. sans Vert (Deshayes' ed.), vol. 10, p. 37.

1845 *Cassis semigranosus*, Lam; Catlow and Reeve, Conchologists' Nomenclator, p. 263, No. 37.

1848 *Cassis semigranosa*, Lam; Reeve, Conch. Icon, vol. 5, pl. 1, species 3.

1850 *Cassis semigranosum*, Jay, Catalogue of Shells, 4th edition, p. 345, No. 8,736.

1853 *Semicassis semigranosa*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 216.

1856 *Buccinum (Cassis) semigranosum*, Hanley in Wood Index Test. Supplement, p. 212, pl. 4, fig. 2.

1857 *Cassis semigranosa*, Wood; Kuster in Martini and Chem., 2nd edition, p. 24, pl. 44, figs. 6-7.

1859 *Cassis semigranosus* (Semicassis), Chenu, Manual de Conch., tome 1, p. 206, fig. 1,124.

1860 *Cassis semigranosa*, Lam; W. Theobald, Catalogue of the Recent Shells in the Museum Asiatic Society of Bengal, p. 18, No. 10.

1865 *Semicassis semigranosa*, Lam; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 168, No. 75.

1873 *Cassis (Phalium) semigranosa*, Lam; Paetel, Catlog der Conch., Sammlung, pp. 5-44.

1877 *Cassis semigranosa*, Lam; Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 33.

1885 *Cassis (Semicassis) semigranosa*, Wood; Tryon in Manual of Conchology, p. 275, pl. 3, fig. 60.

This well-known *Cassis* was first described by the great French author, Chevalier de Lamarck, in 1822, and figured by Wood in his Supplement to the Index Testaceologicus, 1828, as *Buccinum semigranosum*, from the British Museum. It is quoted by Kiener in his Spécies Général et Iconagraphie des Coquilles Vivantes as of Lamarck until 1857, when Dr. Kuster, in the second edition of the Conchylien Cabinet, quotes Wood as the authority. Other authors have quoted Lamarck. In 1885 Mr. Tryon quotes Wood, and then quotes Reeve Conch. Icon. for his information. The information

that I have found in Reeve Conchologia Iconica is that he quotes *Cassis semigranosa*, Lamarck, Anim. sans Vert (Deshayes' edit.), vol. x, p. 37. There is not any mention of Wood in the matter—probably an oversight on the part of Dr. Kuster and Mr. Tryon. These errors are are very misleading to those who do not possess a large library of works to consult for information. I have received the *Cassis semigranosa* from many Australian collectors quoted both as of Lamarck and of Wood. I trust this list which I have drawn up will clear up many points of authorship, and be of value to my Tasmanian friends.

Hab.—Seas of New Holland (*Lamarck*); "—— ?" (*Wood*); coast of New Holland (*Kiener, Kuster*); Van Diemen's Land, now Tasmania (*Hanley, Reeve*); Tasmania (*Tenison-Woods*); Aldinga Bay, Encounter Bay, South Australia (*G. F. Angas*).

12. Mitra Capensis. Dunker, sp.

1845 *Mitra Capensis*, Dunker Reeve, Conch. Icon. Mitra, pl. 7, figs. 33-268.

1848 *Mitra Capensis*, Dunker; Krauss, Sudafrikanschen Mollusken, p. 125.

1851 *Mitra rufocincta*, A. Adams, Proc. Zool. Soc., p. 134.

1854 *Volutamitra vincta*, A. Adams, Proc. Zool. Soc., p. 134.

1873 *Mitra (Pusio) Capensis*, Paetel, Catalog.-Conch., Sammlung, p. 39.

1873 *Mitra (Volutamitra) vincta*, Paetel, Catalog.-Conch., Sammlung, p. 40.

1874 *Mitra Capensis*, Dunker; Sowerby, Thes. Conch., vol. 3, p. 25; Mitra, pl. 28, fig. 654.

1874 *Mitra rufocincta*, A. Adams; Sowerby, Thes. Conch., vol. 3, p. 25, pl. 20, fig. 420, pl. 28, fig. 653.

1874 *Mitra vincta* (C. B. Adams!!). Sowerby, Thes. Conch., p. 25, pl. 23, figs. 520-521.

1877 *Mitra weldii*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 31.

1882 *Mitra Capensis*, Dunker; Tryon, Manual of Conchology, vol. 4, p. 125, pl. 37, figs. 95-92-94; *Mitra Weldi*, Tenison-Wood, l.c., p. 125.

Many years ago I sent specimens of this species to the late Mr. H. Adams, and they were duly returned, named *Mitra vincta*, A. Ad. Some time after I received a number of specimens from Mr. Legrand, of Hobart. I returned

specimens to him named *Mitra vincta* for the Tasmanian examples banded with dark orange and brown.

Tenison-Woods, in 1877, says:—"This shell was given to him by Mr. Legrand as *M. vincta*, but was unable to trace it," probably through not having works of reference at his command.

Mr. W. F. Petterd informs me that *Mitra vincta* = *Weldii* is a very common species at Long Bay and Blackmans Bay, and from the number of specimens that I have received at various times it shows it to be a very variable species.

I very much doubt its being found at the Cape of Good Hope, as quoted by Reeve. The variety named by A. Adams as *Mitra rufocincta* was described from a single specimen, slightly sea worn, locality not known, and the variety *Mitra vincta*, A. Ad. is said to have come from Cape Natal. Paetel, in his Catalog der Conchylien-Sammlung, 1873, quotes it from New Caledonia; I have never seen it from there. Mr. Sowerby, in the Thesaurus Conchyliorum, erroneously attributes this species to C. B. Adams, and the locality Jamaica. The two specimens figured by Sowerby No. 520, 521, are evidently true Tasmanian shells, and are the so-called *Mitra Weldii*, Tenison-Woods. If it is proved that *Mitra Capensis*, Dunker, is not found at the Cape of Good Hope, the name is a misnomer, and that *Mitra rufocincta*, A. Adams, should replace it.

Hab.—Cape of Good Hope (*Reeve*); Natal, South Africa, (*Tryon*); Long Bay and Blackmans Bay, Tasmania (*W. F. Petterd, Rev. H. D. Atkinson*); Hobson's Bay, Victoria (*J. F. Bailey*).

NOTES ON THE DISCOVERY OF A NEW EUCALYPTUS.

By T. B. Moore.

A few notes on the discovery of a new Eucalypt may be of some interest to the Fellows of the Royal Society, especially the introductory remarks, for which I am greatly indebted to our illustrious honorary member—Baron von Mueller—who thus forwards his determination on what he considers a most important botanical discovery.

During a recent exploration, for the Government, of the country situated between the townships of New Norfolk and Victoria, an Eucalypt which had never come under my observa-

tion during any of my numerous wanderings through the unexplored portions of Tasmania, and one which I could not find described in the Flora of the Colonies, was first observed on a saddle of the dividing range between the Huon and Derwent watersheds.

On this bleak, high land, at an altitude of over 2,000 feet above sea level, the tree attains a height of quite one hundred feet. Further investigations led to the discovery of a splendid forest, extending in a narrow strip for three miles along the southern side of the range. Here, in a less exposed situation and at a much lower elevation, this magnificent tree rises to the stupendous height of two hundred feet; and in many cases, for half that lofty distance its long straight stems are branchless, a most noticeable peculiarity in its growth. The bark is thin, smooth, and of a reddish or chocolate colour; but where the deciduous part is freshly shed, it is mottled with yellowish streaks or blotches. The wood is of a light red colour, extremely hard and surprisingly heavy, and is of a stringy and close-grained character.

These recommendable characteristics of the wood, added to the natural hardiness of the tree—luxuriantly growing, as it does, in unsheltered situations and in poor soil—convinces me that the timber will be found to equal the far-famed wood of the E. globulus, not only in durability, but as a commercial product; and being so highly recommended by so eminent an authority as Baron von Mueller, the tree should most undoubtedly be brought under trial culture and conservation by the Government of the Island, without any unnecessary delay.

As I wished to announce the discovery of this Eucalypt to our Royal Society, before leaving the South of Tasmania, I am unavoidably obliged, on account of not being able to obtain the blossom at the present time, to forward these incomplete notes, but take this pleasurable opportunity to name the new species in honor of Baron Von Müeller, and with his assistance, at some future date, purpose compiling an illustrated paper with systematic comparisons as to its Phytography.

The flower does not expand until next month, but on comparing the unexpanded ones with those of the E. Gunnii, the stamens and anthers seem similar in both.

The leaves of the younger and smaller trees differ very slightly from those of the older and larger ones, the latter being more lanceolate and acuminate than the former. The following is a description of the new species, *Eucalyptus Müelleri*:—Branchlets spreading, cylindrical; leaves thick, alternate, shining and crenulated; lanceolate or ovate, often acuminate, oblique rarely straight; veins indistinct, circumferential vein irregular, but generally close to edge of leaf, oil-glands pellucid. Peduncles

short, detoid and flattened, each with two or three flowers. Calyx-tube much less rounded and more angular than fruit, about three lines long, with a similar diameter at its dilated orifice; operculum short, verrucous, with orbicular point. Fruit hard, generally winged or angled twice, globose or ovoid, from three to four lines in diameter, much dilated at orifice, the rim rounded and slightly prominent, capsule sunk, but valves protruding when open.

INTRODUCTORY REMARKS BY BARON VON MUELLER, K.C.M.G., M. AND PH. D., F.R.S.

"Of the genus Eucalyptus twelve species have hitherto been recorded from Tasmania, and as fairly well marked, three of these being endemic, the others occurring also on the mainland of Australia. The species peculiar to the island are Eucalyptus cordata, E. urnigera, and E. vernicosa—all three linked together by several characteristics, so that it is not always easy to refer occasional aberrant or transitory forms to the species from which they originated. In my Eucalyptography, the E. cordata became rather extensively elucidated, through the kind aid of Mr. T. Stephens and Mr. F. Abbott, its close relation to E. urnigera being then brought under particular notice; but E. vernicosa remained hitherto, in the above-mentioned work, unattended to for want of sufficient material—though already, some years ago, a lithographic drawing of its typical state became prepared and printed. This was withheld from publication, as it seemed likely that the plant, in its very dwarf state, represented the highland form of a taller plant of sub-alpine regions, analogies offered by some other plants also in Tasmania pointing in that direction. Indeed, when ascending Mount Field East in 1869, I came across an Eucalypt, at elevations between 3,000 and 4,000 feet, which rose in that frigid region to fully 30 feet, and which seemed to me rather a tall state of E. vernicosa than a variety of E. Gunnii. Very far away from any settlement, and in so inclement a tract of country, my stay could only be brief—protective cover and provender having to be carried by pedestrians, and a track for some distance to be cut through the dense sub-alpine scrubs. This particular tree differed from the well-known "*Cider-tree*" of Tasmania in its very rigid, dark-green leaves, with a tendency to marginal crenulation, and with a somewhat oily lustre on both parts; moreover the calyces being somewhat verrucular, rough and their opircular portion not prominently pointed, as in the normal state of E. Gunnii, defined by Sir Joseph Hooker's original diagnosis (London "Journal of Botany," III, 499); the fruits being also more abbreviated than those described in 1844, and as delineated by Fitch in 1860 ("Flor. Tasm.," I, Plate xxvii).

From the above remarks it will be perceived that the plant from near the Lakes of Mount Field offers some approach to E. urnigera; and this is borne out by specimens of evidently the same tree just submitted to me by Mr. T. B. Moore, as obtained by him during recent surveys across the Mount Wellington ranges. It rises there even to the stupendous height of 200 feet, half that size being still reached in the cool elevations of 2,000 feet. Mr. Moore observed the bark to be smooth, of a reddish or chocolate colour, but where fresh shed it being mottled with yellowish streaks or blotches. The leaves are ovate-lanceolar, and attain a length of four inches.

It remains now to be shown, in what precise position systematically E. vernicosa is standing to E. urnigera and to E. Gunnii, after this most highly developed state of the former became discovered; but these comparisons can be carried on much better by local observers in the forests themselves, than by observations on necessarily limited and fragmentary material in a remote study-room. But whatever exact place this tree found by Mr. Moore may phytographically occupy, it will add a most important one to the very few of the genus which bear considerable frost; and as the timber is pronounced by that gentleman as extremely hard, close-grained, tough and heavy, this hardy Eucalypt should be brought speedily and extensively under trial culture in cool climates—when also the characteristics of the seedlings would, for diagnostic purposes, come under observation. In conclusion I may add, that the small-leaved dwarf alpine state of E. vernicosa is now known also from Mount Arrowsmith (Gulliver), Mount Norfolk (Emmett), and Mount Sorell (Milligan)."

NOTES ON THE GEOLOGY OF THE KING RIVER, TOGETHER WITH A BRIEF ACCOUNT OF THE HISTORY OF GOLD-MINING IN AUSTRALASIA.

By Robert M. Johnston. F.L.S.

The Archæan and Silurian rocks of Western Tasmania form a series of folds whose axes traverse the country north and south. The great folds generally are anticlines, and are composed principally of quartzite, metamorphic schists, conglomerates, etc.

Queen River Group.

The axis of one of the great north and south anticlines running northward from the Gordon and immediately west

and parallel to the Franklin River, seems to follow in the line of the West Coast Range, including the following rugged peaks, composed mainly of slates, conglomerated and quartzite, viz. :—Elliot Range, Craycroft Range, Mount Darwin, Mount Jukes, Mount Huxley, Mount Owen, Mount Lyell, Mount Sedgwick, Mount Tyndal, Mount Murchison. The line seems to disappear near the waters of the Mackintosh Valley, which trends westward to the Pieman. It is on the eastern and western slopes of the Elliot Range anticline where the lower Gordon River Group crops up to the surface. Between Mount Jukes and Mount Huxley the King River cuts through the same great axis on its westward course to the head of Macquarie Harbour. At a short distance west of the northern extremity of Mount Jukes the King River receives a tributary — the Queen River, — which flows southward from the southern slopes of Mount Sedgwick. The Queen River, like the Franklin, runs parallel to the ranges named which compose the crest of the anticlinal axis.

On the western side of the Queen River a subordinate ridge, sometimes rising into conspicuous prominences, as at Honeysuckle Hill, runs parallel to the Queen River and to the axis referred to. Thus, the Queen River runs in a trough formed along the strike of the Gordon River Group. The subordinate ridge referred to is composed of an interesting series of rocks, principally hydro-mica slates, with casts of encrinites and fenestellæ, and a fine greyish white gritty sandstone, replete with imperfect impressions of brachiopods. The brachiopod sandstones and hydro-mica slates are grouped as "The Queen River hydro-mica schists and slates," and from their position in relation to the main axis, and from the facies of the fossil organisms, I am inclined to believe that they not only succeed the members of the Gordon River Group, but mark the lower limits of the Upper Silurian division, and it is worthy of observation that the recently discovered auriferous "lodes" at Mount Lyell occur traversing rocks which appear to be identical with the hydro-mica schists of the group found a little further to the south.

The first evidence of the fossiliferous rocks in this part of the country was obtained by Mr. T. B. Moore, while engaged in opening up new tracks in this rugged country in the neighbourhood of the King River in the year 1884. Specimens of the "brachiopod sandstone" were also obtained for me by Mr. Atkins, of Hobart, from the same vicinity, but at a point nearer the Macquarie Harbour.

Although the impressions of casts of brachiopods are very numerous, they are invariably imperfect, and rarely exhibit

traces of the finer superficial characters. Notwithstanding this, I have observed a series of fragments of forms which seem to me to be closely allied to *Spirifera crispa* (Hesinger), and *S. plicatella* (Linn.), *Orthis flabellum, and O. elegantula.* As similar fossils are obtained in the water-worn nodules of sandstone forming part of the Dial Range and Table Cape conglomerates, it is probable that the conglomerate has been derived from the waste of members belonging to the group of rocks of which the Queen River hydro-mica slates, schists, and sandstones are representatives. It is probable that the "brachiopod sandstone" occurs in the neighbourhood of Table Cape, but its presence as a bed-rock has not yet been discovered.

With respect to the party, 32 in number, organised by Mr. Chas. Gould, in 1862 and 1863, for the purpose of searching for gold and other minerals in the vicinity of the King and Gordon Rivers, it is now of the greatest interest to reproduce an account of the general results of their labours. It is true, Mr. Gould confesses in his report, that the expedition was somewhat disappointing, yet he was able to state that "the appearance of the country was more favourable than that presented by any other part we prospected, and although drift-gold was discovered by the party, as in previous cases, in small quantities in river drifts, we were unable to meet with it in anything like paying quantities."

Steel grey and yellow clay-slates, resembling those of the Mersey district, occur both in the King and Gordon Rivers, while a gradual passage into the metamorphic rock is presented by the granular quartzites and micaceous schists existing on the western side of the harbour, between Wellington Head and the Coast.

Mr. Gould further states that "it is reasonable to anticipate that all of this may be auriferous, although to what extent it is impossible to say. It is probable that some divisions of the formation may prove richer than others, and that hence the most valuable tracts will be found to lie in zones running in accordance with the prevalent strike in the direction from 20deg. to 30deg. W. of N. and E. of S." He was full of hope with regard to the King River district, having readily obtained traces of gold in minute specks in the bed of this river and its tributaries, for he states (p. 6)—"The character of the slates met with in the King River was much more promising than those existing elsewhere in the district, and I at one time entertained hopes that the favourable appearance might have been confirmed by results. This, however, was not the case, for, although what gold we obtained was slightly coarser than in other localities, the quantity was inconsiderable."

Seeing that the Linda and the Eldon tributaries of the

King River drain the southern, northern, and eastern slopes of Mount Lyell, while the Queen River branch drains the western slopes, we have now little difficulty in coming to a conclusion regarding the occurrence of fine specks of gold in the bed of the main stream further south. No doubt the fineness of the gold would favour its wide dissemination along the course of the main stream, especially when it was mechanically held bound by a lighter mineral. Other localities where gold was traced by Gould's party are stated to be in the vicinity of Frenchman's Cap, base of Mount Arrowsmith, Macquarie Harbour, Lake Dixon, Point Hibbs, junction of the Franklin with the Gordon, &c.

Mr. Gould strongly urged that this country should be more thoroughly investigated, and the results at Mount Lyell 24 years later seem to justify his hopes and predictions.

Since Mr. Gould's expedition left the locality no systematic prospecting was done until the discovery of tin at Mount Heemskirk, when prospectors made hurried examination of all the more accessible localities. Amongst these prospectors, Mr. Lynch, in a most persevering manner, penetrated to and examined the ground now held by the King River Prospecting Company, where he discovered very rich auriferous quartz, and from this all subsequent discoveries in the locality have resulted.

Reports referred to.—Report Macquarie Harbour by C. Gould, Paper 26, House of Assembly, 1862 (map). Ditto, ditto. Exploration for gold, *ibid.* House of Assembly Paper, No. 9, 1863.

Dial Range and North-West Coast Conglomerates.—

Massive beds of coarse conglomerates occur in many places in Western Tasmania. With our present knowledge it would be unwise to suppose they all belong to the same horizon, for some of them mentioned by Mr. Gould as being associated with the Gordon Group, and others forming bold ridges at Frenchman's Cap, may yet prove to be more ancient than those whose positions are deemed to belong to the present sub-division of Upper Silurian age. The members which may with some degree of safety be recognised as succeeding the Gordon and Queen River Groups are to be found on the Dial Range, which forms a bold conspicuous line of hills in the neighbourhood of the Penguin.

With still greater certainty may be included the coarse, highly indurated conglomerates upon which the Tertiary marine beds at Table Cape repose. These conglomerates are as a rule composed of greatly altered water-worn pebbles derived from various ancient rocks. Pebbles composed of highly indurated fossiliferous bluish-grey limestones and

yellowish gritty sandstones are of common occurrence, and in these Mr. James Smith, Mr. Thomas Hainsworth, and the writer have at various times obtained specimens containing impressions of several species of brachiopods apparently identical with forms occurring in the limestones and gritty sandstones of the Gordon and Queen River Groups. These conglomerates have been described by the writer in the Proceedings of the Royal Society of Tasmania, 1876, pp. 86-87, and they extend, somewhat interruptedly, reposing unconformably upon a more or less vertically inclined slate formation, along the coast between Table Cape and the Penguin. In these localities they usually form dangerous reefs along the coast line. They have evidently been subjected to great denudation, and this may account for this irregular and interrupted distribution. It is difficult to determine the species, as the specimens or casts are fragmentary or imperfect. Fortunately, a number of these fossils were submitted by Mr. T. Stephens, and also by the writer, to Mr. Robert Etheridge, jun., of the British Museum, who described and figured the more conspicuous forms in a paper submitted to the Royal Society of Tasmania in the year 1882.—(See Proc. Roy. Soc. Tas., 1882, pp. 150-163; Plate II., figs. 1-16). The prevaling form is a species of *Pentamerus*, closely allied to *P. Knightii* (Sby.), and described as *P. Tasmaniensis* (Pl. II., figs. 1 and 3-8) by Mr Etheridge, jun. The associated forms also commented and described by the same authority are as follow :—

1. *Spirifer*, resembling *S. plicatella* (Linn.) (Figg. 9, a-c.)
2. *Spirifer*, or *Orthis*, "possessing the usual ribs and a smooth mesial fold." (Pl. II., fig. 2).
3. *Spirifer*, "not unlike *S. crispa* (His.) or *S. elevata* (Dalman)." (Fig. 9-b.)
4. *Orthis*, well marked, "a ventral valve with but few ribs, and those coarse and strong," resembling *O.biforata* (Schlothiem.) (Fig. 16.)
5. *Strophomena ?* fragment of a shell. (Fig. 11.)
6. *Spirifer ?* or *Atrypa ?* (Fig. 10.)
7. *Tentaculites ;* cast. (Fig. 13.)
8. Internal cast of a bivalve, undetermined. (Fig. 15.)

Besides these I have in my possession other forms from the conglomerates, resembling the following species :—

Orthis alternata.
Orthis flabellum.
Orthis elegantula (Dalman).
Rhynchonella nasuta (M'Coy).
Atrypa hemispherica (J. de C. Sow).

As forms strongly resembling these also occur *im situ* in the gritty sandstones of the Queen River, and also in a similar formation on the Corinna Track north of Long Plain, where they were obtained by Mr. James Smith, it is very probable that the fossiliferous portions of the conglomerates were derived from such rocks, and hence we are safe in referring them to a higher position, as in the present classification. This conclusion is to some extent borne out by Mr. T. Stephens, who has expressed an opinion that certain boulders contained in the conglomerates have even been "derived from rocks which are not older than the Lower Carboniferous or Devonian period." This must be a matter for future observation to settle. In the meantime I assign them a position in the Upper Silurian rocks between the Queen River group and the soft slates of Eldon Valley and Fingal. The latter formations have been deemed by Mr. Gould to be more recent than any other member of the Upper Silurian observed by him in Tasmania.

Eldon Valley Clay-slates and Mudstones.—In the Eldon valley Mr. Gould describes the occurrence of clay-slates and mudstones, containing fossil remains of undermined species of the following genera, viz. :—

Calymene.
Orthis.
Cardiola, &c.

The rocks of this group are to be found in a section described by the same observer between North Eldon River and the eastern extremity of Camp Hill. On either hand the metamorphic schists rise from under them towards the Rivers Murchison and Alma respectively, and evidently the latter have been formed in a deep syncline of the older metamorphic schists. Mudstones similiar in character to the Eldon beds are also described by Mr. Gould as cropping out near the mouth of the Gordon, where they are supposed to be succeeded by certain soft-clay slates at Head Quarters Island, which, on lithological grounds, Mr. Gould deemed to be the equivalents of those at Fingal. It is unfortunate that the fossils obtained by Mr. Gould are not now available as guides to local workers. The difficulties of access to this part of the country prevent us from obtaining more precise information regarding the stratigraphy and other matters of interest. It is shown, however, that in certain high peaks overlying the Eldon beds isolated bosses of greenstone appear whose bases are obscured by Upper Palæozoic marine mudstones and still more recent sandstones, among which, under peaks farther to the east (Coal Hill), beds of coal of supposed Mesozoic age are known to occur. It is apparent that denudation has removed the

greater part of these later rocks, and has thus exposed the older rocks upon which they orginally rested. Boulders derived from these Upper Palæozoic rocks are found in the King River.

Mount Lyell and the Linda Goldfield.

Through the kindness of Mr. Jas. Crotty, and Mr. Belstead, Secretary of Mines, I have recently received a very fine collection of rocks from the neighbourhood of Mount Lyell and Mount Owen, which, with former collections from the same locality, afford valuable information respecting the geology of this interesting auriferous region. Since these were received, Mr. Thureau's report of the Linda Goldfield has been published, and his observations confirm the accuracy of the description given already by Messrs. T. B. Moore, J. Crotty, and others.

From the various sources of information, we learn that the major axis forming the West Coast Range, including the lofty peaks already named, are mainly composed of the following rocks in ascending order:—

1. Hydro-mica schists and slates, frequently of a soft unctuous nature, grandular and laminated in structure, with a prevailing silvery white or pearly lustre.
2. Indurated laminated hydro-mica schists frequently with fine tubular markings, and containing imperfect impressions of marine organisms (Strophomena, Spirfera, Fenestella etc.), overlying No. 1.

dipping to the West at an angle of from 60deg. to 80deg.

3. Indurated bands of granular or crystalline quartz of an igneous appearance, and of a pinkish colour on weathered surface, intimately associated with bands of a friable decomposed grit also of a pinkish hue, composed mainly of quartz and felspar.

dipping to the South, at an angle of from 25deg. to 40deg.

4. Coarse breccias and conglomerates, white and pinkish, forming the caps of Mount Owen, Mount Lyell, and other lofty crests, worn, furrowed and often isolated from contiguous masses, by long continued denudation.

It is evident that Nos. 3 and 4 are of a much later age than 1 and 2, and in all probability more recent than the Brachioped sandstone of the Queen River group, which may probably succeed Nos. 1 and 2.

It is not improbable, therefore, that the capping conglomerates of Mount Lyell and Mount Owen may be of the same horizon as the Dial Range and Table Cape conglomerates, which are known to contain similar fossils.

The rich auriferous deposit, now famous as "The Iron Blow," occurs on the low ridge connecting Mounts Lyell and

Owen, drained on the eastern side by the River Linda, and on the western side by the Queen River (both tributaries of the King River). The "Iron Blow," worked by the Mount Lyell Gold-mining Co., appears to be quite unique in the history of gold mining. Hitherto, in Tasmania at least, reef gold has been worked in quartz veins or dykes, traversing the Lower Silurian slates, quartzites, or conglomerates.

The "Iron Blow" has little resemblance to the ordinary auriferous veins. The absence of quartz throughout the more characteristic parts of the auriferous formation is especially remarkable. Where it does occur within the defined walls of the "blow" it is inconspicuous.

From various accounts it would seem that the formation occupies an enormous chasm penetrating or traversing the hydro-mica schists, the walls of which are stated by Mr. Thureau to be fully 280 feet apart. The outcrop of the "Iron Blow" has been traced for about $1\frac{1}{2}$ miles along its strike. The deposit itself is variously termed "lode," "iron blow," "blue iron," and "auriferous iron schists."

The strike of the principal fissure is nearly parallel with the direction of the southern face of Mount Lyell and North Mount Lyell, *i.e.*, in a direction nearly North 28° W.

Mr. Thureau also states that both hanging and foot walls, so far as they have been observed, dip at an exceedingly high angle in the same direction; the former at an angle of about 75 degrees. W., the latter about 64 degrees West. Where the mass of auriferous stuff is worked, a cross section has disclosed that about 57 feet, or about a fifth of the width, is composed of the more richly auriferous matrix, consisting mainly of peroxide of iron and barytes, either of a soft laminated character, or pulverised into a powdery mass of a dark purplish color. The remaining four-fifths, or western portion of the section, is in the form of solid pyrites; but an analysis made for me by Mr. Fred. Ward, the Government Analyst, proves that it is essentially the same in character as the softer mass to the east, and the latter is no doubt simply a decomposed form of the more solid pyrite mass of the western side. Strings and veins of solid barytes also are found penetrating the mass; and gold is found, in more or less extraordinary richness throughout the whole ferruginous mass.

When it is affirmed, as stated by Mr. Thureau, that the dark purple-colored rock has yielded at the rate of 187oz. per ton, its phenomenal richness is at once appreciated; and although it is too much to expect that this average will be maintained generally, it is enough to indicate that the deposit is probably the richest hitherto known.

The following analyses, kindly prepared by Mr. Ward, are of much value, as they will afford to those who are interested

in the mode of origin of the auriferous deposit at the Linda better materials for forming an opinion :—

NOTES ON SPECIMENS OF MINERALS FROM MOUNT LYELL (CROTTY'S CLAIM).

No. 7 (IRON BLOW, 56 FEET WIDE).

Composition.	*Per Cent.*
Iron Pyrites	77·75
Barium Sulphate (Barytes)	19·85
Water, etc., lost at a red heat	2·40
	100·00

Specimen of deep purplish colour, soft and pulverulent, with indications of lamination becoming apparent as the Iron Peroxide dissolves out in Hydrochloric Acid. The residue insoluble in acid consists of Crystalline Barytes more or less regularly disseminated throughout the mass; fine specks of gold just visible to the naked eye present in residue.

IRON PYRITES.—No. 9.
(2 chains wide, partly overlying No. 7).

Composition.	*Per Cent.*
Iron Bisulphide (Pyrites)	83·0
Barium Sulphate (Barytes)	17·0
	100·0

Specimen oxidised on exposed surfaces and in cracks, easily cut with knife owing to the presence of the crystalline Barium Sulphate diffused through it. The particles of this barytes differ but little in appearance from those left on treating with acid portions of the "Iron Blow."

No. 11 (CAP OF No. 10.)

Composition.	*Per Cent.*
Iron Peroxide	63·9
Barium Sulphate	2·2
Silica (Quartz)	18·5
Water, &c., lost at red heat	15·4
	100·0

Specimen yellow from *hydrated* Iron Peroxide.

No. 10 (EAST OF No. 7).

Quartz or Quartzite? contained 3·6 per cent. of Barytes, the remainder being chiefly Silica with a little Iron Oxide. This specimen has a distinct schistozie structure and cleavage.

Nos. 5 and 6—Footwall of lode.

Two specimens of Hydromica.

The darker colour of one specimen was due to the presence of organic matter from decomposing vegetation.

Mr. Ward also states :—"From results herewith (which are

approximate only, and of course refer only to the very small specimens received) and from the description of occurrence in report by Inspector of Mines, and there seems little room for doubt that the 'Iron Blow' is the result of oxidations of Pyrites similar to that now associated so largely with it; the hydrated Oxide first formed being subsequently metamorphosed sufficiently to get rid of its combined water, and produce the slight change in the form of the small disseminated particles of barytes, as revealed by the microscope; or this change may have occurred during the process of oxidation. By oxidation three parts by weight of Iron Pyrites would yield two parts of Iron Peroxide."

From these analyses it would seem that the presence of barytes with iron and sulphur in the monster "Iron Blow" does not present any greater difficulty as regards mode of origin than is to be found in determining the mode of origin of the ordinary auriferous quartz or other metalliferous veins. I quite agree with Mr. Thureau in regarding the deposit as a most extraordinary one so far as auriferous workings are concerned, although the association of barytes in a small crystalline form with gold is known to occur in one or two gold mines in New South Wales, notably at the Canobolas and Winterton mine, Mitchell's Creek, near Bathurst.

Barytes is also often present in veins of lead, silver, and other minerals as the gangue of the ore, and as at the Linda it often occurs as an accessory, in a lamellated form, notably in the clay strata of Monte Perno, near Bologna.

Whether we suppose that the "Iron Blow" is due to hydrothermal agency or not, there is nothing in the composition of the pyrites or dark purplish rock which necessitates their having been formed originally in the way of "volcanic mud." It is more probable that the four principal elements, iron, barytes, sulphur, and gold, were originally precipitated together from solution. There is not the slightest correspondence between the Mount Morgan and Mount Lyell auriferous deposits.

Mr. Jack considers the auriferous formation at Mount Morgan to be derived from a thermal spring or geyser during the Tertiary age, and adds that "the frothy silicious sinter agrees in every respect with the deposits of New Zealand and Iceland geysers, and of the still more wonderful hot springs of the Yellowstone National Park." There is little resemblance between the silicious sinter, without definite bounds,of Mount Morgan, and the defined "fissure" at the Linda with its auriferous peroxide of iron and barytes, and I am inclined to the opinion that the formation at the latter

place cannot have originated later than the Devonian era at least.

As there are many speculations by able authorities regarding the mode of origin of gold whether associated with quartz or otherwise, I have specially added an appendix to this paper, briefly dealing with the history of gold mining in Australasia. In it will be found a reference to the speculations of various authorities regarding its mode of origin. The one most commonly accepted, viz., "hydrothermal agency," is that which was favored by Dr. Barnard in a paper read before this Society in the year 1880. This theory is also favored by Dana, Lyell and other authorities, and it would appear also to be adopted by Mr. Thureau in respect of such mineral formations as the "Iron Blow" at the Linda, although the latter seems to be unaware of the fact that the mode of origin of the more common auriferous quartz reefs are also frequently ascribed to hydrothermal agency.

GOLD.

Gold is classed with silver, platinum, iridium, and palladium, as one of the noble metals, and is widely distributed throughout the world, principally in the rocks of Archæan and Cambro-Silurian age. It occurs mostly in a native state, being either pure or only slightly alloyed with one or other of the following metals, viz., silver, tellurium, copper, iron, bismuth, palladium, rhodium. Although gold often richly occurs in the drifts, conglomerates, and igneous rocks of more recent systems,—notably those of Tertiary age,—it is now very generally acknowledged that the gold so found has been derived primarily from the decomposition and waste of the auriferous quartz reefs and veins which occur chiefly in rocks of Silurian and Devonian age. It was from the more recent auriferous superficial drifts, composed of clay, sand, and gravel, that gold was first derived by man. Reef gold mining, according to Davies, "although the oldest mode of occurrence in nature, is the one more recently known to men, and still more recently worked with success. Excepting some Brazilian mines, and one of doubtful success in the Ural Mountains, there was, only forty years ago, scarcely a gold mine profitably worked in the solid rock."

Important Gold Discoveries in Modern Times.

The following brief summary is confined to the more important discoveries of gold in the great producing centres of modern times. For the facts relating to ex-Australian centres I am indebted to Davies' useful work, "Metalliferous Minerals and Mining," 8vo., pp. 438; London, 1851.

Russia.—Gold was first discovered in the Ural Mountains in the year 1723, and this region still continues to rank as one of the chiefest sources of the world's supply of gold.

Austro-Hungary.—Gold has been mined in Hungary since the eighth century. In the existing Amalia mine, near Schemitz, gold is worked to a depth of 1,800 feet from the surface.

Central America.—Gold was discovered in Nicaragua in 1850—that is, only a year prior to Hargreaves' discovery of payable gold in Australia. In Brazil gold has been known to Europeans since 1543. The more important mines, still being worked successfully, near St. John del Rey, were first systematically developed by an English Company in the year 1830.

California.—The first important discovery of gold in California was accidentally made in 1847 by Mr. Marshall, at Sutter's Mill, situated on the American Fork, near its junction with the Sacramento. The gold was first discovered as shining yellow particles in a newly formed mill-race in connection with Colonel Sutter's saw-mill.

Australia.—Mining for gold in Australia commenced in the year 1851, immediately upon the discoveries of payable gold-fields by Hargreaves at Ophir in the beginning of the same year. Prior to this date the attention of colonists was not attracted to the subject.

The earliest recorded discovery of gold, however, is that of Mr. Surveyor M'Brian. Of this discovery Mr. Harrie Wood[a] gives the following account:—"Mr. Surveyor M'Brian, in his field notes of the survey of the Fish River, between Tarana and O'Connell, states:—'February 15, 1823.—At 81·50 to river, and marked gum-tree. At this place I found numerous particles of gold in the sand in the hills convenient to the river.'"

In 1839, Count Strzelecki, at Boree and Wellington caves, found gold in specks in silicate, but was induced by the Governor of the colony to refrain from giving publicity to the discovery, as it was feared such knowledge would make it impossible to preserve discipline among the soldiers and prisoners.

In 1841, the Rev. W. B. Clarke discovered gold at the head of the Winburndale Rivulet, and in the granite westward of the Vale of Clwydd; but although, in 1843, he had mentioned the matter generally, it was regarded as a curiosity only, "and considerations of the penal condition of the colony

[a] Mineral products of New South Wales, 1882, p. 22 See also the *Evening News* of Sydney for 7th August, 1875.

kept the subject quiet, as much as the general ignorance of the value of such an indication."[b]

In 1844 and 1846, without knowing anything of the previous discoveries, Sir R. Murchison published upon scientific grounds a prediction of the existence of gold in Australia. The following account, given by himself, is of much interest to Australians:—"Having recently returned from the auriferous Ural Mountains, I had the advantage of examining the numerous specimens collected by my friend Count Strzelecki along the eastern chain of Australia. Seeing the similarity of the rocks of those two distant countries, I could have little difficulty in drawing a parallel between them, in doing which I was naturally struck by the circumstance that none had *yet* been found in the Australian ridge, which I termed in anticipation the 'Cordillera.' Impressed with the conviction that gold would, sooner or later, be found in the great British colony, I learnt, in 1846, with satisfaction that a specimen of the ore had been discovered. I thereupon encouraged the unemployed miners of Cornwall to emigrate and dig for gold as they dug for tin in the gravel of their own district. *These notices were, as far as I know, the first printed documents relating to Australian gold.*" I have italicised the part which indicates that Sir R. Murchison was not led to make his sagacious predictions because of knowledge of what have since been revealed of earlier discoveries of gold by persons residing in the colony. The following testimony of Count Strzelecki indisputably confirms this view[c]:—"Nothing can give me greater pleasure and comfort at any time than to bear my humble testimony to the inductive power which you displayed on the occasion of your predictions in regard to the existence of gold in Australia; and consequently I can affirm now, as I did and do whenever necessity occurs, that I never mentioned my discovery or supposed discovery of Australian gold to you prior to your papers on the subject, nor after their publication."

The effect of the discovery of gold in payable quantities in 1851 gave a wonderful impulse to the search for gold in all the colonies, and within a month of the establishment of Victoria as an independent colony it became generally known that rich deposits of gold existed within its borders.

The results of the Select Committee appointed by the Legislative Council of Victoria to consider the order of priority of claims for gold discoveries in Victoria, is thus summarised in Mr. Hayter's Year Book, 1885, p. 24:—

b See Rev. W. B. Clarke's evidence before a Select Committee of Leg. Council, N.S.W., Sept. 1852. *Parl. Papers.*

c Presidential Discourse Trans. Royal Geol. Soc., 1884; also Murchison's Siluria, 1852, pp. 450—451

"The Hon. W. Campbell discovered gold in March, 1850, at Clunes; concealed the fact at the time from the apprehension that its announcement might prove injurious to the squatter on whose run the discovery was made, but mentioned it in a letter to a friend on the 10th June, and afterwards on the 5th July, 1851, which friend, at Mr. Campbell's request, reported the matter to the Gold Discovery Committee on the 5th July. Mr. L. J. Mitchell and six others discovered gold in the Yarra Ranges at Anderson's Creek, which they communicated to the Gold Discovery Committee on the 5th July. Mr. James Esmond, a California digger, and three others obtained gold in the quartz rocks of the Pyrenees, and made the discovery public on the 5th July. Dr. George Bruhn, a German physician, found indications of gold in quartz, 'two miles from Parker's station, in April, 1851, and forwarded specimens to the Gold Committee on the 30th June.' Mr. Thomas Hiscock found gold at Buninyong on the 8th August, and communicated the fact to the editor of the *Geelong Advertiser* on the 10th of the same month. This discovery led to that of the Ballarat gold-fields. Mr. C. T. Peters, a hutkeeper at Barker's Creek, and three others found gold at Specimen Gully on the 20th July; worked secretly to the first September; then published the account. This led to the discovery of the numerous gold-fields about Mount Alexander."

In New Zealand gold was discovered in 1842, less than three years from the foundation of the colony; but it was not practically worked until 1852, *i.e.* after Hargreaves' discovery in New South Wales. Mining for gold was first commenced at Coromandel, in the district of Cape Colville Peninsula, which, at the present time, forms the chief seat of true mining operations in New Zealand[a], and where reefs have been proved to a depth of over 600 feet below sea level.

In Queensland the opening of the gold-fields only occured about the year 1859, or about the time when it was severed as an independent colony from New South Wales.

In Tasmania, the first payable gold was found in 1852, about the Nook, near Fingal, and about the same time it was discovered in minute particles along the Tower Hill Creek and in the vicinity of Nine Mile Springs.[b] The first quartz mine commenced operations at Fingal in the year 1859. In the same year gold was found in the River Forth by Mr. James Smith, and also good prospects at the Calder, a tributary of the Inglis, by Mr. Peter Lette. At Lefroy (Nine Mile Springs) reef gold was discovered by S. Richards in the

a. See New Zealand Hand Book, by James Hector, M.D., C.M.G., F.R.S., 1879, p.

b Mr. Riva, of Launceston, is stated to have traced gold in slate rocks in the vicinity of Nine Mile Springs about the year 1849.

year 1869. Traces of gold were also obtained in several places between Hadspen and the town of Launceston. Gold was also discovered in the western and north-western portions of the island by Messrs. Gould, Jas. Smith, C. P. Sprent, Peter Lette, and S. B. Emmett The first recorded returns from the Mangana goldfields date from 1870; Waterhouse, 1871; the Aellyer, Denison, and Brandy Creek, in 1872; Lisle, in 1878; Gladstone and Cam, in 1881; Minnow and River Forth, in 1882; Branxholm and Mount Victoria, in 1883; Mount Lyell, in 1886.

EXTENT OF GOLD PRODUCE.

The importance of the gold industry in Australasia is best indicated by the fact that 76,462,619 ozs. of gold, valued at £300,864,352 were raised between 1851 and 1883.

The proportions yielded by the various colonies are thus given by Mr. Hayter[a]:—

	Quantity. *ozs.*	*Value.* *£*
Victoria.....	52,214,150	208,856,600
New South Wales.....	9,432,759	34,971,319
Queensland.....	4,170,254	14,939,304
South Australia	133,181	529,771
Tasmania.....	335,728	1,291,826
New Zealand.....	10,276,547	40,275,532
Total	76,462,619	300,864,352

The value of gold raised in Australasia during 1883 is estimated at £5,522,751, and the quantity at 1,411,712ozs., of which nearly two-thirds were obtained from the reefs or veins in the solid rock.

The average gold produce of the world during the last fifty years is variously estimated at between 23½ and 29 millions per year.

According to Mulhall[b] the gold produce of the world for the fifty years ending 1880 amounted to £1,448,000,000, *i.e.*, equal to an average of £28,960,000 per year.

Of the total amount for the fifty years, the same authority

a Year Book of Victoria, 1885, p. 384.
b Dictionary of Statistics, p. 220; Victorian Year Book, 1885, p. 384.

estimates that the percentages yielded by the principal and other sources of supply were as follow :—

	Per cent.
Mexico and South America.....	31·5
United States.....	19·7
Australasia.....	17·8
Russia	12·0
Other countries.....	19·0
Total.....	100·0

According to a report furnished to the British House of Commons, however, the gold produced between 1855 and 1875, presents a marked difference in the percentage for various countries, viz.:—

	Per Cent.
United States	42·43
Australasia	36·95
Russia	15·08
Mexico and South America	3·39
Other countries	2·15
Total	100·00

It would appear from the latter statement, therefore, that during the last thirty years the United States and Australasia together have produced 79·38 per cent. of the world's supply of gold.

Mr. Hayter estimates that the proportion of gold derived from quartz and alluvial in Victoria for the years 1883 and 1884[c] was—

Quartz, 60 per cent.

Alluvial, 40 per cent.

In Tasmania I find, from an analysis of the latest statistical records, that between 1866 and 1885 the total quantity of gold produced from quartz and alluvial was as follows :—

	ozs.		*Per cent.*
Quartz.....	253,636	or	67·04
Alluvial	124,732	or	32·96
Total.....	378,368	or	100·00

c Dana's Manual of Mineralogy and Lithology, p. 114.

Gold Produced in the Various Mining Districts of Tasmania between 1866 and 1884.

DISTRICT.	GOLD.			*Per cent. to Total.*
	Alluvial.	*Quartz.*	*Total.*	
	ozs.	ozs.	ozs.	
Beaconsfield	30,900	150,484	181,384	47·94
Lefroy and Back Creek	8,575	77,435	86,010	22·73
Lisle	62,800	—	62,800	16·70
Mangana and Black Boy	5,970	9,994	15,964	4·21
West Coast	11,907	—	11,907	3·20
Fingal	2,171	6,734	8,905	2·35
Mount Victoria	—	4,195	4,195	1·01
Waterhouse and Denison	60	2,548	2,608	·67
Gladstone	—	1,674	1,674	·44
Hellyer	585	—	585	·15
Minnow River & Forth River	200	7	207	·05
Cam	192	—	192	·05
Branxholm	50	13	63	·01
Other places	1,322	552	1,874	·49
Total	124,732	253,636	378,368*	100·00
Per cent to total	32·96	67·04	100·00	

* The value is estimated at £1,453,309.

GOLD REEFS.

Gold reefs in Tasmania have not yet been worked to any great depth. The following particulars with respect to the principal shafts sunk have been kindly supplied to me by Mr. C. J. Atkins :—

District.	*Depth of Shaft. feet.*	*Direction of Reef.*
Lefroy—		
New Native Chum	812	Strike east and west]
New Chum	404	„ east and west 6° S.
Mathinna—		
City of Hobart	650	„ north and south (a little to east of south.)
Beaconsfield—		
Lefroy Co	400	„ east and west, dipping south
Tasmania	277½	„ ditto.
Florence	268	„ ditto.
Dally's United	200	„ ditto.
South Esk—		
Chesterfield's shaft	270?	

These reefs vary from a few inches to 5 feet in width.[b]

a Victorian Year Book, 1885, p. 385.
b The so-called auriferous "lode" at Mount Lyell is stated to be over 280 feet thick. It is ferrugineous rather than quartziferous in character.

The reefs in New South Wales vary from a few inches to 10 feet in width, and have generally a meridional strike,—although there are exceptions showing a strike N. and S., as at Hill End, Trunkney, and Adelong; at Dalmorta, from E. 10° N. to E. 30° S.; at Grenfell, N.E.; at Temora and Copeland, N.E. to E. and S.E.

With respect to Victoria, Mr. W. Nicholas, F.G.S., has furnished valuable information, which is thus summarised by Mr. Brough Smith, F.G.S.[a]:—

"Of eight hundred and forty-one distinct reefs observed in the Lower Silurian strata, two-thirds have an average direction of strike bearing N. 20° W., and the remaining third an average direction bearing N. 11° E.; and that of one hundred and fifty-seven reefs examined in the Upper Silurian rocks, three-fourths have an average direction along the strike of N. 34° W., and one-fourth an average direction bearing N. 27° E. In addition about eighty-five cross reefs have been observed, varying in the direction of the strike from N. 85° W. to N. 74° E. These are so called from their divergence at nearly right angles from the prevailing courses of the reefs. . . . The reefs which occur in the Lower are much thicker than those in the Upper Silurian rocks, and that, so far as yet observed, those reefs showing the greatest thickness have been found to be the richest and most extensively wrought in Victoria."

The shafts sunk in Victoria as a rule attain a much greater depth than in New South Wales and Tasmania. Mr. Hayter states[b]:—

"At least 17 of the shafts sunk in Victoria in search of auriferous quartz have attained depths exceeding 1,000 feet. The deepest shaft in the colony is the Magdala, at Stawell, which is 2,409 feet, or nearly half-a-mile deep, and other shafts in the same locality are 1,940, 1,830, 1,815, 1,770, 1.676, and 1,326 feet from the surface. At Sandhurst the shaft of Lansell's 180 mine is 2,041 feet deep, and that of the Victory and Pandora Company is 2,000 feet deep. There are also shafts 1,778, 1,563, 1,490, 1,483, and 1,450 feet deep respectively; at Maldon there is one 1,220 feet deep; and at Clunes there is one shaft 1,210, and another 1,193 feet deep."

In New South Wales, shafts have not been sunk to a much greater depth than in Tasmania. At Adelong a shaft has been sunk to the depth of 874 feet. Two other shafts have reached the depth of 830 feet and 716 feet respectively.

The yield of gold from Tasmanian quartz reefs varies considerably from year to year. The yield at Beaconsfield varied from 1oz. 5dwts. 6grs. per ton in 1882, to 1oz. 0dwts. 16grs.

a. Report of Progress Geol. Survey of Vict., No. IV., p. 14.
b. Victorian Year Book, 1885, p. 388.

in 1883; at Lefroy, the yield in 1882 was 10dwts. 13grs. per ton, and in 1883 the yield fell off to 7dwts. 22grs. The average yield from all quartz reefs in Tasmania for 1883 was 15dwts. 9grs. In Victoria, it is stated that the average yield of the crushings in 1883 and 1884 was 9dwts. 12·82grs. and 9dwts. 21·07grs. respectively. In the deepest mines the yields varied from 4dwts. 17grs. to 2ozs. 6dwts. 14grs. per ton.

Gold Nuggets.

In Tasmania, alluvial gold has not been worked to the same extent as in the Australian mainland, and the only nuggets of importance recorded are the following:—

(1.) Nugget found at Long Plains by Buckner, May, 1882. Weight, 9ozs.

(2.) Nugget found on the Whyte River by M'Guinty and party, March, 1883. Weight, 243ozs.

(3.) Nugget found on the White River by Griffen and party, March, 1883. Weight, 143ozs.

Models of these Tasmanian nuggets are exhibited in the Tasmanian Museum, Hobart.

The largest masses of gold known have been found as nuggets in alluvial workings. The "Welcome Nugget," found in Victoria, weighed 2,195 ounces, or nearly 183 pounds, and yielded £8,396 10s. 6d. of sterling gold. From South Australian alluvial workings the "Blanch Barkley Nugget" was obtained, which weighed 146lbs. Besides the "Welcome Nugget," two other nuggets were found in Victoria, weighing 1,621 and 1,105 ounces respecitvely.

On the 13th May, 1851, soon after the gold discovery in New South Wales by Hargreaves, there was discovered at Summer Hill Creek, N.S.W., a nugget weighing 1lb. 1oz. This is probably the first nugget of importance found in Australia. The most remarkable nuggets found in New South Wales weighed 106 and 107lbs. Troy respectively. Of these the first was found by a native boy in July, 1851, at Meroo Creek, or Louisa Creek, River Touron; the second was found on 1st November, 1858, at Burradong, near Orange. An interesting account of the more remarkable nuggets found in New South Wales is given by Professor Liversidge.—("The Minerals of New South Wales," Sydney, 1882, pp. 66-69.)

Dana, in his Manual of Mineralogy and Lithology, p. 115, also informs us that masses of gold of considerable size have been found in North Carolina. The largest was discovered in Cabarrus County; it weighed 28 pounds avoirdupois—(steelyard weight equals 37 pounds Troy.) . . . . In Paraguay, pieces from 1 to 50 pounds weight were taken

from a mass of rock which fell from one of the highest mountains . . . . The largest mass yet reported from California weighed 134lbs 7ozs. A remarkably beautiful mass, consisting of a congeries of crystals weighing 101 ounces (value $4,000), was found in 1865, seven miles from George Town, in El Dorado County. At Maisk, in the Ural Mountains, a nugget of gold was found—weight, 96lbs. It would seem, therefore, that the largest masses of gold known were found in Australia.

Theories Regarding the Origin of Gold Veins and their Mode of Occurrence.

Regarding the origin of gold found in quartz veins, there is much that is obscure or little understood. Of course nearly all authorities now agree in referring the formation of auriferous quartz veins to an aqueous origin. But suppose we admit that the gold is carried into rock fissures in solution with quartz from certain strata in the surrounding rocks, we have still to enquire how and from whence came the gold there in a finely-divided state? What is the true cause of shoots of gold? Why, for example, are auriferous quartz veins principally confined to rocks of Palæozoic age? Why should particular rocks, say diorite, appreciably affect the deposition of gold in veins passing through that rock? What is the exact thermal condition and the exact nature of the fluid which will hold silica, gold, and other metals in solution at the same time and in such a manner that they may in some form be deposited together? Many speculations have been advanced by able authorities, which, though of great value, fail to satisfy all the conditions required to arrive at a proper appreciation of the subject.

According to J. Arthur Phillips,[a] the formation of auriferous veins is now going on in various parts of the Pacific Coast. He states (see p. 601, Lyell's Elements of Geology)—"For example, there are fissures at the foot of the eastern declivity of the Sierra Nevada, in the State of that name, from which boiling water and steam escape, forming siliceous incrustations on the sides of the fissures. In one case, where the fissure is filled up with silica, enclosing iron and copper pyrites, gold has also been found in the veinstone." And again, with reference to California, he states:—"The auriferous quartz of these drifts is derived from veins apparently due to hydrothermal agency." Again, Sonsdadt states that "the sea water of the British coasts contains in solution, besides silver, an appreciable amount of gold, estimated by him at about one grain to a ton of water."[a]

a Phillips on "The Goldfields of California."—Proc. Roy. Soc. Lond., 1868.
a J. Sterry Hunt.

Richard Muller, from experiments conducted by him, established the fact that "solvent action is more facilitated by increased pressure than by prolonged digestion," and hence probably the speculation of J. C. Crawford,[b] who supposes that mineral veins have been formed in the depths of the sea, and speculates thus:—"The filling of metallic veins, particularly gold and silver, has chiefly taken place at a depth of about 2,500 fathoms or over; the precipitation may have proceeded from metals in the waters of the ocean, or in passes, or in water heated from below."[c] According to Sonsdadt, iodine in sea water is the agency which keeps gold in a soluble and oxidised condition.[d] Dana[e] is of opinion "the veins of quartz which contain the gold occupy fissures through the slates and openings among the layers which must have been made when the metamorphic changes or crystallization took place. It was a period for each gold region of long-continued heat (occupying probably a prolonged age), and also of vast upliftings and disturbances of the beds; for the beds are tilted at various angles, and the veins show where the fractures of the layers or the separations and gapings of the tortured strata. The heat appears not to have been of the intensity required for the better crystallization of the more perfectly crystalline schists. The quartz veins could not have been filled from below by injection; they must have been filled either laterally or from above. In all such conditions of upturning and metamorphism the moisture present would have become intensely heated, and hence have had great dissolving and decomposing power; it would have taken up silica with alkalies from the rocks (as happened in all Geyser regions), along with whatever other mineral substances were capable of solution or removal, and the vapour, thus laden, would have filled all open spaces, there to make depositions of the silica and other ingredients it contained. The mineral ingredients would have been derived from the rock adjoining the veins or open spaces, or from depths below through ascending vapours. By one or both of these means the quartz must have received its gold, pyrites, and ores of lead, copper, and other materials, all having been carried into the open cavities at the same time with the silica or quartz. The pyrite of the vein is usually auriferous, showing that it was crystallized under the same circumstances that attended the deposing of gold in strings, crystals, and grains, and the same is often true of the galena."

With respect to the mine waters of Australasia, Messrs.

b Trans. New Zealand Inst., Vol. IX., pp. 570-561.
c Geol. Record, 1877.
d. Brough Smythe.
e Manual of Mineralogy and Lithology, 1879, p. 115.

Newberry, Taylor, Skey, and others have conducted experiments for determining the presence of gold, which they had reason to believe was held in solution in the saline waters of the deep mines. Mr. Newberry states that considerable difficulty is experienced in conducting experiments on this subject, as extreme care is requisite to exclude all possible chance of the presence of finely-divided gold, which has been held in mine-waters either by itself or with pyrites, quartz, and earthy matter. With such precautions Mr. Newberry admits that a portion of the evidence had to be discarded, and the final results were not deemed to be conclusive on the point. Much investigation is yet necessary before we can arrive at final conclusions respecting the origin of gold in quartz veins.

In this place it is of interest to observe that Sir R. Murchison's settled opinion of the "downward impoverishment of gold-bearing quartz veins" has not been sustained by practical experience in Australia, where gold is now successfully worked in many places over 2,000 feet below the surface, and in one place at 2,409 feet, or nearly half-a-mile deep. His peculiar views with respect to the superficial distribution of gold, and of the downward persistence of silver, were no doubt coloured to a great extent by the idea that the sacred writer of Job[a] indicated such a form of distribution as regards gold and silver, in the aphorism—

"Surely there is a *vein* for the silver. . . . The earth hath *dust of gold*."

His fears for the ultimate failure of the gold supply were therefore unnecessarily increased.

NOTES AND DESCRIPTIONS OF CRINOIDEA FROM THE UPPER PALÆOZOIC ROCKS OF TASMANIA.

By Robt. M. Johnston, F.L.S.

ENCRINITE STEMS FROM PACHYDOMUS BEDS, DARLINGTON, MARIA ISLAND.

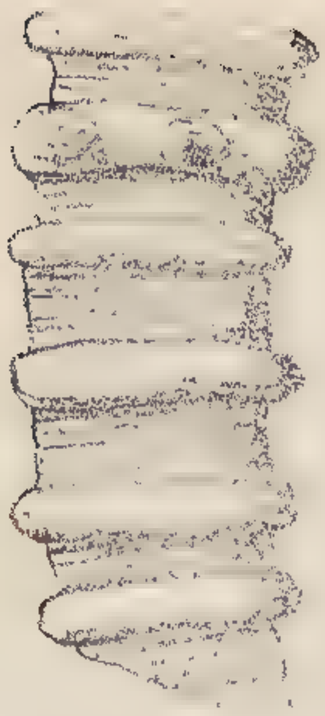
I have recently examined a very interesting collection of articulated encrinite stems, variously sculptured, obtained by Mr. Perrin. The inside casts of similar forms are also of common occurrence in the Porter Hill and Shot Tower beds. In the Darlington specimens, however, the external sculpture is exhibited in great perfection. As these forms may be of service in matters relating to the correlation of the various divisions of the Upper Palæozoic rocks, I have taken pains

to figure the more characteristic examples of these curious jointed stems. It is somewhat interesting to observe that all the varieties of stems have branching whorls (generally five) at regular intervals, with an occasional one or two odd "auxiliary arms" springing irregularly from the axis between the regular whorls. The three variously sculptured varieties may belong to different parts of the column or its auxiliary arms. The calyx of these stems has not yet been observed.

No. 1 represents a large round stem composed of articulated joints of an irregularly moniliform character; joints from about 12 to 15 millimetres in diameter; articulating surfaces, marked with fine radiating striæ near the margin; surface of stem ornamented with somewhat distant, raised annular ribs or nodes, each about 5 to 6 millimetres apart, the flattened and constricted interspaces with 5 or 6 annular liræ, a large and small one usually alternating. At regular intervals, about every fifth of the larger annular nodes, there is a still larger node, from which five "auxiliary arms" radiate outwards and upwards. The node is somewhat swollen at the junction of each auxiliary. The whole of the surface rings on some of the specimens seem to be crossed by very fine oblique striæ, giving them a granular appearance. The different parts of the stem, however, show great variation in sculpture, although preserving the general moniliform character. In parts of about 10 millimetres in diameter the nodes are less distant, and the intervening annular liræ are fewer and relatively coarser. The "alimentary canal" is central, conspicuous, though ill-defined. There is an appearance of a pentagonal form in some sections of the alimentary canal.

No. 2 is a stem composed of simple, regular ovate joints, generally more flattened on one side than on the other. Each joint is regularly divided by a well-marked suture about 3 millimetres apart, sometimes showing the crenulated edges of the striæ marking the articulating surfaces; the surface of each ring is simple and flatly rounded. Alimentary canal exceedingly fine, sub-central; articulating surface ornamented with fine striæ, longest and most marked on the side most distant from canal. At distant intervals there is a joint somewhat larger, carrying two auxiliary arms. This joint is divided in the middle by a very fine annular suture, which is well marked in the junction scar of auxiliary branch. Greatest diameter, 12 to 13 millimetres; smallest diameter, 7 millimetres.

No. 3 is a simple stem like No. 2, but smaller and more rounded. From a polished section, however, it is clear that in the earlier stage of growth it was somewhat oval and more flattened on one side, like No. 2, and that the alimentary



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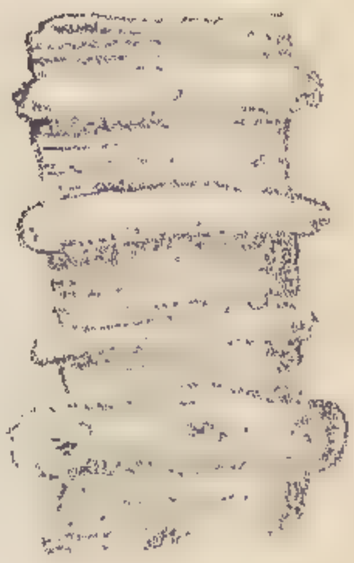

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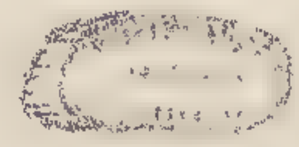

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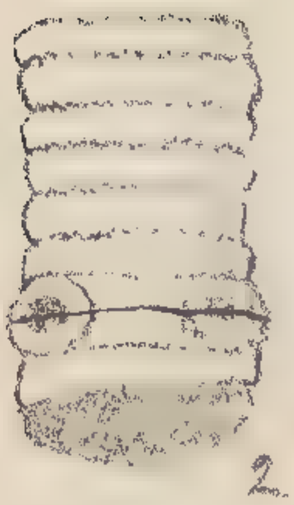
3c

Tribrachiocrinus Tasmanicus R.M.Johnston.



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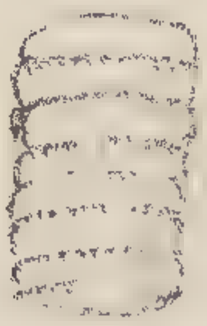

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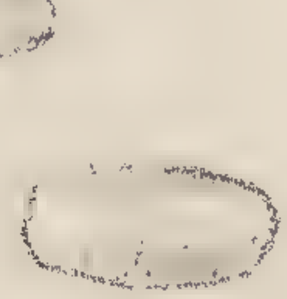

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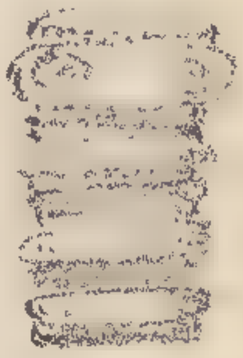


1b

TASMANIAN CRINOIDEA.

canal is sub-central. There appears to be excentric rings of growth almost wholly confined to the side furthest from axis of alimentary canal, which can with difficulty be traced. The joint carrying auxiliary arms has the same character as No. 2, but there are either four or five "auxiliary arms," and in one specimen there is a solitary auxiliary placed lower upon an ordinary joint. Greatest diameter, 8 millimetres; least, 7 millimetres; distance of annular sutures apart, 2 millimetres.

No. 4 is, no doubt, the extreme portions of auxiliary arms probably of either No. 2 or 3, composed of fine, simple, rounded moniliform joints, about $1\frac{1}{2}$ millimetres in diameter, gradually tapering.

Tribrachyocrinus Tasmanicus? Nov. sp.

Perforation of large pentagonal tripartite pelvis or dorsocentral plate exceedingly minute, apparently absent; costal plates large, roundly pentagonal; one plate (first costal) irregularly hexagonal; margins of plates marked with fine parallel concentric striæ. Specimen much distorted, having a broadly oval form. Length, 3 inches; width, 2 inches.

Associated with *Spirifera convoluta*, *Sanguinolites Etheridgei*, etc., in Upper Palæozoic mudstone cliffs at Shot Tower, Brown's River-road.

Specimen obtained by Mr. A. Morton, Curator of Tasmanian Museum, from the collector, Mr. Harrison. The above species comes very close to, and perhaps may not be specifically distinct from, the smaller form with large perforation in tripartite pelvis described by Prof. M'Coy as *T. Clarkei*, from the soft grey shales of Darlington, N.S.W.

NOTES ON FOSSIL CRABS FROM THE DEEP DREDGINGS OF THE YARRA RIVER, AND EXCAVATION OF THE COODE CANAL, VICTORIA.

By S. H. Wintle, F.L.S., &c.

The accompanying fossil crustacea I obtained from the deposits of deep dredgings of the Yarra river, and from the material deposited from the excavation of the Coode Canal. The age of the old Estuarine bed which supplied them is Post Pliocene. These cancerolites belong to the Genera

Phlyxia and *Utica* (Haswell), and exist in Australian waters now. *Utica* are very numerous, *Phlyxia* scarce. At present I can only forward examples of *Utica Yarraensis* (Wintle), but hope to be able to supply specimens of *Phlyxia.*

DESCRIPTION.

Utica Yarraensis (Wintle), carapace sub-quadrate, smooth, naked, rounded, convoluted, trilobed, anterior margin nearly straight. Antero-lateral margin with one small conical tooth in living examples. Posterior margin unarmed. Postero-lateral margin edges recurved. Eye-stalks short, depressed. Ambulatory appendages fine, tomentose, terminal, and penultimate; joints fringed below with fine hairs; jaw legs long, slender, second joint twice as long as first one. Jaws slight, attenuated. Abdomen without deep mesial furrow. Third and sixth segments coalescent in both sexes.

Shores of Port Phillip, Port Jackson, and possibly Tasmania.

Utica Haswelli (Wintle), carapace subquadrate, broader than long, smooth, convoluted, trilobed. Anterior margin shield-shaped, edges finely recurved. Two deep lateral furrows. Ambulatory appendages finely tomentose, long, same as in *U. Yarraensis.* A close ally to *U. barbimana* (Haswell).

Associated with these crabs are the remains of the small freshwater crayfish, *Astacopsis Franklinii* (McCoy); the river mussel, *Unio* sp., both of which have been brought down from the fresh water by river action, and with them are also found marine testaceous remains in abundance. (See examples.)

I purpose at a future early date sending further examples from this interesting deposit, with diagrams of section of the stratigraphy of the canal cutting.

SYSTEMATIC LIST

OF

TASMANIAN BIRDS:

BY

COL. W. V. LEGGE, R.A., F.Z.S., &c.

NOTE.—In the following Systematic List, the Birds of Tasmania are divided into 12 Orders. The object has been to supply workers in Ornithology with an idea as to the proper classification of our birds, prior to the issue of a systematic catalogue, which it is hoped will be published next year. By the term "proper" must be understood a classification that will group together such families as are manifestly allied to one another, and place them in that sequence which is the natural outcome of the affinities of the genera of one family with those of another. There are, it is true, gaps to be found in most of the great recognised Orders which are difficult to bridge over; but, as a rule, members of one family (or sub-family) are found, by reason of their anatomy or their habits, to grade into one another in such a manner as to enable the systematist to group them in a natural sequence.

So long as the world lasts there will be differences of opinion as to the right classification of birds; and therefore the best course to be followed by the systematic student of the avifauna of a small "region" like that of Tasmania is to adopt such a system as will work easily, provided the claims of anatomy and external structure, combined with the affinities demonstrated by habit, are not ignored.

The system followed in this List is that adopted in the Birds of Ceylon, with some slight modifications. The *Accipitres* (Hawks) are placed first, and the Hawks are followed by the *Psittaci* (Parrots) with their similarly hooked

bill and fleshy cere at the base of the upper mandible. After these follow the *Picarian* birds, with a double notch in the posterior margin of the sternum or breast-bone: and the separation of the birds of this group from the great *Passerine* Order, together with the subdivision of the latter into the Sections proposed by Wallace, based on wing-structure, constitute the chief differences from the classification in Gould's works, with which Tasmanian students will no doubt be familiar. After the *Columbæ* (Pigeons) and *Gallinæ* (Scratchers or Game Birds) come the Coots and Water-hens, &c., which I have kept distinct, as the Order *Fulicariæ*, from the *Grallæ* (Shore-birds). This order, recognised by some naturalists and not by others, I take to be a good one, inasmuch as the Coots are entirely distinct from the shore-birds in their habits and eggs, although their young are like those of the latter Order *Autophagous*. The Petrels are placed with the Gulls and Terns in one Order, *Gaviæ*, and not separated as *Tubinares*, although it must be admitted that the nidification and eggs of the Petrels are very distinct from those of the Gulls. In their oceanic habits, however, they grade into the the Terns somewhat, through the "Noddies."

There has been an unnecessary separation of genera in many families of Australian birds. There is nothing more perplexing to the young student than this, and I have, in cases where there are no differences of external structure, discarded many such genera. It has been found necessary, however, to separate the so-called *Great Acanthiza* as a new genus *Acanthornis*, which will appear in a paper on Tasmanian Birds in *The Ibis* for 1887.

The specific names are in some cases different from those in Gould, owing to the researches of modern authors having resulted in tracing out older (and consequently more correct) names than those employed by that naturalist. The new title given to the Scarlet-breasted Robin by Mr. Sharpe in his 4th volume of the Catalogue of Birds is owing to the specific name, *Multicolor*, having been originally applied by Gmelin to the Norfolk Island Robin, and therefore a new name had to be found for and bestowed on the Australian and Tasmanian bird. *Geocichla macrorhyncha*, I am inclined to think, is a doubtful species; It can only rank in any case as a sub-species, if it be distinct from *G. lunulata*, the Australian Thrush. With the paucity of data which exists concerning the Petrels, I have not thought it advisable to subdivide this neglected family at present. I have likewise thought it better to keep the blue and white Reef Herons as one species.

Order **ACCIPITRES.**

Suborder **Falcones.**

Family FALCONIDÆ—(11 species).

Subfam. ACCIPITRINÆ.	Circus approximans, *Bonap.*	Allied Harrier (Swamp-hawk).
	Circus assimilis, *Jard. & Selby.*	Jardines Harrier.
	Astur Novæ Hollandiæ, *Gmelin.*	White Goshawk.
	Astur approximans, *Vigors & Horsf.*	Australian Goshawk.
	Accipiter cirrhocephalus, *Vieillot.*	Sparrow-hawk.
Subfam. AQUILINÆ.	Uroætus audax, *Latham.*	Wedge-tailed Eagle.
	Haliætus leucogaster, *Gmelin.*	Grey-backed Sea Eagle.
Subfam. FALCONINÆ.	Falco melanogenys, *Gould.*	Black-cheeked Falcon.
	Falco lunulatus, *Latham.*	Australian Hobby.
	Hieracidea Orientalis, *Schlegel.*	Brown Hawk.
	Cerchneis cenchroides, *Vig. & Horsf.*	Australian Kestrel.

Suborder **Pandiones.**

	Pandion leucocephalus, *Gould.*	Australian Osprey.

Suborder **Striges.**

Family BUBONIDÆ—(2 species).

Subfam. BUBONINÆ.	Ninox boobook, *Latham.*	Brown Hawk-owl.
	Ninox maculata, *Vig. & Horsf.*	Spotted Hawk-owl.

Family STRIGIDÆ—(1 species).

	Strix castanops, *Gould.*	Tasmanian Barn-owl.

Order **PSITTACI.**

Family PSITTACIDÆ—(8 species).

Subfam. CAMPTOLOPHINÆ.	Plictolophus galeritus, *Latham.*	White Cockatoo.
	Calyptorynchus xanthonotus, *Gould.*	Black Cockatoo.
	Callocephalon galeatum, *Latham.*	Gang-gang Cockatoo.

Subfam. Platycercinæ.	Platycercus flaviventris, *Temminck.*	Yellow-bellied Parrakeet.
	Platycercus eximius, *Shaw.*	Rosehill Parrakeet.
	Euphema venusta, *Temminck.*	Blue-banded Grass Parrakeet.
	Euphema chrysogastra, *Latham.*	Orange-bellied Grass Parrakeet.
	Pezoporus formosus, *Latham.*	Ground Parrakeet.

Family TRICHOGLOSSIDÆ—(4 species).

Subfam. Trichoglossinæ.	Lathamus discolor, *Shaw.*	Swift Lorikeet.
	Trichoglossus, Novæ Hollandæ, *Gmelin.*	Blue-bellied Lorikeet.
	Trichoglossus concinnus, *Shaw.*	Musk Lorikeet.
	Trichoglossus pusillus, *Shaw.*	Little Lorikeet.

Order **PICARIÆ.**

Family CUCULIDÆ—(5 species).

Subfam. Cuculinæ.	Cuculus pallidus, *Latham.*	Pallid Cuckoo.
	Cuculus flabelliformis, *Latham.*	Fantailed Cuckoo.
	Cuculus plagosus, *Lath.*	Bronze Cuckoo.
	Cuculus basalis, *Horsfield.*	Narrow-billed Bronze Cuckoo.
Subfam. Phænicophainæ.	Scythrops Novæ Hollandiæ, *Lath.*	Channel-bill Cuckoo.

Family ALCEDINIDÆ—(2 species).

Subfam. Halcyoninæ.	Halcyon sanctus, *Vig. & Horsf.*	Sacred Kingfisher.
Subfam. Alcedininæ.	Alcyone Diemenensis, *Gould.*	Tasmanian Kingfisher.

Family CYPSELIDÆ—(1 species).

	Acanthyllis caudacuta, *Lath.*	Spine-tailed Swift.

Family CAPRIMULGIDÆ—(2 species).

Subfam. Steatorninæ.	Podargus Cuvieri, *Vig. & Horsf.*	More-pork.
Subfam. Caprimulginæ.	Ægotheles Novæ Hollandiæ, *Lath.*	Crested Night Jar.

Order **PASSERES.**

Section A. **Thrush-like Passeres.**

(10 primaries, 1st small.)

Family CORVIDÆ—(4 species).

Subfam. Corvinæ.	Corvus coronoides, *Vig. & Horsf.*	Australian Raven.
	Corone Australis, *Gould.*	White-eyed Crow.
	Strepera fuliginosa, *Gould.*	Black Magpie.
	Strepera arguta, *Gould.*	Hill Magpie.

Family CAMPOPHAGIDÆ—(1 species).

Graucalus parvirostris, *Gould.*	Summer-bird.

Family PRIONOPIDÆ—(1 species).

Collyriocincla rectirostris, *Jard. & Selby.*	Whistling Shrike-Thrush.

Family LANIIDÆ—(5 species).

Subfam. Gymnorhininæ.	Gymnorhina hyperleuca, *Gould.*	Magpie.
	Cracticus cinereus, *Gould.*	Butcher-bird (Jack-ass.)
Subfam. Pachycephalinæ.	Pachycephala olivacea, *Vig. & Horsf.*	Olivaceous Thick-head.
	Pachycephala gutturalis, *Lath.*	Yellow-breasted Thickhead.
	Pachycephala glaucura, *Gould.*	Grey-tailed Thick-head.

Family MUSCICAPIDÆ—(8 species).

Subfam. Muscicapinæ.	Rhipidura saturata, *Sharpe.*	Tasmanian Fantail.
	Myiagra rubecula, *Lath.*	Leaden Flycatcher.
	Myiagra nitida, *Gould.*	Shining Flycatcher.
Subfam. Saxicolinæ.	*Petræca Leggii, *Sharpe.*	Scarlet-breasted Robin.
	Petræca Phœnicea, *Gould.*	Flame-breasted Robin.
	Petræca Rhodinogaster, *Drapier.*	Pink-breasted Robin.
	Petræca vittata, *Quoy et Gaimard.*	Dusky Robin.
	Malurus Gouldi, *Sharpe.*	Long-tailed Warbler (Blue Wren).

* See Note.

Family TURDIDÆ—(3 species).

Subfam. TURDINÆ.	Geocichla macrorhyncha, *Gould.*	Ground Thrush.
Subfam. SYLVIINÆ.	Acrocephalus Australis, *Gould.*	Reed Warbler.
Subfam. EPHTHIANURINÆ.	Ephthianura albifrons, *Jard. & Selby.*	White-fronted Chat.

Family TIMELIIDÆ—(8 species).

Subfam. CRATERPODINÆ.	Cinclosoma punctatum, *Lath.*	The Ground Bird (Ground Dove).
Subfam. TIMALIINÆ.	Calamanthus fuliginosus, *Vig. & Horsf.*	Rush Warbler.
Subfam. BRACHPYTERINÆ.	Megalurus gramineus, *Gould.*	Grass Bird.
	Stipiturus malachurus, *Shaw.*	Emu Wren.
Subfam. ACANTHIZINÆ.	Sericornis humilis, *Gould.*	Sombre Bush Tit.
	* Acanthornis magna, *Gould.*	White-breasted Bush Tit.
	Acanthiza Diemenensis. *Gould.*	Brown Tail.
	Acanthiza chrysorrhœa, *Q. & G.*	Yellow Tail.

Family MELIPHAGIDÆ—(10 species).

Subfam. MELIPHAGINÆ.	Acanthorynchus tenuirostris, *Lath.*	Spine Bill.
	Melithreptus validirostris, *Gould.*	Strong-billed Honey-eater.
	Melithreptus melanocephalus, *Gould.*	Black-headed Honey-eater.
	Glycyphila fulvifrons, *Lewin.*	Fulvous-fronted Honey-eater.
	Ptilotis flavigula, *Gould.*	Yellow-throated Honey-eater.
	Meliornis Novæ Hollandiæ, *Lath.*	New Holland Honey-eater.
	Meliornis Australasiana, *Shaw.*	Tasmanian Honey-eater.
	Manorhina garrula, *Lath.*	Garrulous Honey-eater (Miner).
	Acanthochæra inauris, *Gould.*	Wattle-bird.
	Acanthochæra mellivora, *Lath.*	Brush Wattle-bird.

* See NOTE.

Section B.

Swallow-like Passeres.

(9 Primaries).

Family ZOSTEROPIDÆ—(1 species).

Zosterops cærulescens, *Lath.* White-eye.

Family DICÆIDÆ—(3 species).

Pardalotus punctatus, *Shaw and Nodder.* Diamond Bird.
Pardalotus affinis, *Gould.* Allied Diamond Bird.
Pardalotus quadragintus, *Gould.* Forty-spotted Diamond Bird.

Family HIRUNDINIDÆ—(2 species).

Subfam. HIRUNDININÆ. Hirundo neoxena, *Gould.* Australian Swallow.
Petrochelidon nigricans, *Vieill.* Tree Swallow.

Family FRINGILLIDÆ.

Subfam. FRINGILLINÆ. Estrelda bella, *Lath.* Fire-tailed Finch.

Family MOTACILLIDÆ—(1 species).

Anthus Australis, *Vig. & Horsf.* Australian Pipit.

Section B.

Starling-like Passeres.

(10 Primaries, 1st rudimentary.)

Family ARTAMIDÆ—(1 species).

Artamus sordidus, *Lath.* Wood Swallow.

Order **COLUMBÆ.**

Family GOURIDÆ—(2 species).

Phaps calcoptera, *Latham.* Bronze-wing.
Phaps elegans, *Temminck.* Brush Bronze-wing.

Family TRERONIDÆ—(2 species).

Lamprotreron superbus, *Temm.* Superb Fruit Pigeon.
Lopholaimus antarcticus, *Shaw.* Topknot Pigeon.

Order **GALLINÆ.**

Family TETRAONIDÆ—(3 species).

Coturnix pectoralis, *Gould.*	Stubble Quail.
Synöicus Diemenensis, *Gould.*	Swamp Quail.
Synöicus Australis, *Latham.*	Brown Quail.

Family TURNICIDÆ—(1 species).

Turnix varius, *Latham.*	Painted Quail.

Order **FULICARIÆ.**

Family RALLIDÆ—(8 species).

Porphyrio cyanocephalus, *Vieillot.*	Blue Coat.
Tribonyx Gouldi, *Sclater.*	Native Hen.
Fulica Australis, *Gould.*	Australian Coot.
Hypotœnidia pectoralis, *Cuvier.*	Pectoral Rail.
Hypotœnidia brachypus, *Swainson.*	Short-toed Rail.
Porzana fluminea, *Gould.*	Spotted Crake.
Porzana palustris, *Gould.*	Little Crake.
Porzana tabuensis, *Gmelin.*	Red-backed Crake.

Order **GRALLÆ.**

Family SCOLOPACIDÆ—(9 species).

Gallinago Australis, *Latham.*	Australian Snipe.
Limosa uropygialis, *Gould.*	Barred-rumped Godwit.
Tringa subarquata, *Güldenot.*	Curlew Stint.
Tringa acuminata, *Horsf.*	Marsh Stint.
Tringa ruficollis, *Pallas.*	Red-breasted Stint.
Strepsilas interpres, *Linn.*	The Turnstone.
Numenius cyanopus, *Vieillot.*	Australian Curlew.
Numenius Phæopus, *Linn.*	The Whimbrel.

Family CHARADRIIDÆ—(10 species).

Subfam. HIMANTOPODINÆ.	Himantopus leucocephalus, *Gould.*	Australian Stilt.
	Himantopus pectoralis, *Dubus.*	Banded Stilt.
	Recurvirostra rubricollis, *Temm.*	Red-necked Avocet.
Subfam. CHARADRIINÆ.	Squatarola Helvetica, *Linn.*	Grey Plover.
	Charadrius fulvus, *Gmelin.*	Golden Plover.
	Ægialitis bicincta, *Jard. & Selby.*	Double-banded Sand Plover.
	Ægialitis monacha, *Geoffroy.*	Hooded Sand Plover
	Ægialitis ruficapilla, *Temm.*	Red-capped Sand Plover.

Subfam. VANELLINÆ.	Lobivanellus lobatus, *Latham.*	Wattled Plover.
	Sarciophorus pectoralis, *Wagler.*	Black-breasted Plover.

Family HÆMATOPODIDÆ—2 species.

Hæmatopus longirostris, *Vieill.*	White-breasted Oyster Catcher.
Hæmatopus unicolor, *Wagler.*	Sooty Oyster Catcher.

Order **GAVIÆ.**

Family LARIDÆ—(8 species).

Subfam. STERNINÆ.	Sterna caspia, *Pallas.*	Caspian Tern.
	Sterna poliocerca, *Gould.*	Bass's Straits Tern.
	Sterna frontalis, *Gray.*	Black-billed Tern.
	Sterna nereis, *Gould.*	Australian Little Tern.
Subfam. LARINÆ.	Larus pacificus, *Latham.*	Pacific Gull.
	Larus Novæ Hollandæ, *Stephens.*	Little Gull.
Subfam. STERCORARIINÆ.	Stercorarius Antarcticus, *Lesson.*	Antarctic Skua.
	Stercorarius crepidatus, *Gmelin.*	Richardson's Skua.

Family PROCELLARIIDÆ—(28 species).

Diomedea exulans, *Linn.*	Wandering Albatross.
Diomedea cauta, *Gould.*	Shy Albatross.
Diomedea culminata, *Gould.*	Broad-billed Albatross.
Diomedea chlororhyncha, *Lath.*	Green-billed Albatross.
Diomedea melanophrys, *Temm.*	Black-eyebrowed Albatross.
Diomedea fuliginosa, *Gmelin.*	Sooty Albatross.
Ossifraga gigantea, *Gmelin.*	Giant Petrel.
Majaqueus equinoctialis, *Linn.*	Spectacled Petrel.
Adamastor cinereus, *Gmelin.*	Great Grey Petrel.
Pterodroma macroptera, *Smith.*	Long-winged Petrel.
Pterodroma atlantica, *Gould.*	Atlantic Petrel.
Pterodroma Solandri, *Gould.*	Solander's Petrel.
Œstrelata Lessoni, *Garn.*	White-headed Petrel.
Œstrelata leucoptera, *Gould.*	White-winged Petrel.
Halobœna cœrulea, *Gmelin.*	Blue Petrel.
Puffinus brevicaudus, *Brandt.*	Short-tailed Petrel.
Fulmarus glacialoides, *Smith.*	Silver-grey Petrel.
Daption capensis, *Linn.*	Cape Pigeon.

Prion turtur, *Banks.*	Dove-like Prion.
Prion ariel, *Gould.*	Fairy Prion.
Prion Banksi, *Smith.*	Banks' Prion.
Prion vittatus, *Illiger.*	Broad-billed Prion.
Procellaria nercis, *Gould.*	Grey-backed Storm Petrel.
Procellaria melanogastra, *Gould.*	Black-bellied Storm Petrel.
Procellaria grallaria, *Vieill.*	White-bellied Storm Petrel.
*Procellaria fregata, *Linn.*	White-faced Storm Petrel.
Oceanites oceanica, *Kuhl.*	Yellow-footed Storm Petrel.
Halodroma urinatrix, *Lath.*	Diving Petrel.

Order **STEGANOPODES.**

Family PELECANIDÆ—(5 species).

Sula serrator, *Banks.*	Australian Gannet.
Phalacrocórax carbo, *Linn.*	Common Cormorant.
Phalacrocorax leucogaster, *Gould.*	White-breasted Cormorant.
Phalacrocorax melanoleucos, *Vieill.*	Little Cormorant.
Pelecanus conspicillatus, *Temm.*	Australian Pelican.

Order **ANSERES.**

Family ANATIDÆ—(12 species).

Subfam. CYGNINÆ.	Cygnus atratus, *Lath.*	Black Swan.
Subfam. ANSERINÆ.	Cereopsis Novæ Hollandiæ, *Lath.*	Cape Barren Goose.
	Bernida jubata, *Lath.*	Maned Goose.
	Dendrocycna Eytoni, *Gould.*	Eyton's Tree Duck.
	Tadorna tadornoides, *Jard. & Selby.*	Ruddy Sheldrake.
Subfam. ANATINÆ.	Stictonetta nevosa, *Gould.*	Freckled Duck.
	Anas superciliosa, *Gmelin.*	Wild Duck.
	Anas castanea, *Eyton.*	Chestnut-breasted Duck.
	Spatula rhynchotis, *Lath.*	AustralianShoveller.
	Malacorhynchus membranaceus, *Swains.*	Membranaceous Duck.

* Added 1886 by Mr. E. Atkinson, to our list.

Subfam. Fuligulinæ.	Fuligula Australis, *Gould.*	White-eyed Duck.
Subfam. Erismaturinæ.	Biziura lobata, *Shaw.*	Musk Duck.

Order **HERODIONES.**

Family ARDEIDÆ—(5 species).

Ardea Pacifica, *Lath.*	Pacific Heron.
Ardea Novæ Hollandæ, *Lath.*	White-frontedHeron.
*Ardea sacra, *Gmelin.*	The Reef Heron.
Herodias alba, *Linn.*	White Egret.
Nycticorax Caledonicus, *Lath.*	Australian Night Heron.
Botaurus poicilopterus, *Wagler.*	Australian Bittern.

Order **PYGOPODES.**

Family PODICIPIDÆ—(3 species).

Podiceps Australis, *Gould.*	Australian Grebe.
Podiceps Nestor, *Gould.*	Hoary-headed Grebe.
Podiceps Novæ Hollandiæ.	Australian Little Grebe.

Order **IMPENNES.**

Family SPHENISCIDÆ—(3 species).

Catarractes chrysocome, *Lath.*	Crested Penguin.
Eudyptula minor, *Forster.*	Little Penguin.
Eudyptula undina, *Gould.*	Fairy Penguin.

* See NOTE.

ON THE POSITION OF THE GENUS *EPHTHIANURA*.

[By Col. W. V. Legge, R.A., F.Z.S.]

This singular and interesting genus, which is located by Gould next to *Acanthiza*, finds a place in the 7th Vol. of Sharpe's "Catalogue of Birds," among the somewhat heterogeneous family of the *Timeliidæ*. This family is reserved by the author for a large number of "Turdiform" birds with hollow-shaped wings, many of which are allied in some points to the thrushes, warblers, and fly-catchers, but cannot well be placed with them, owing to existing features of dissimilarity. In the Catalogue, *Ephthianura* is associated with *Accentor*, the typical species of which is the well-known Hedge Sparrow of Europe, the two genera forming the group *Accentores*. It is open to question whether either of these genera should be placed on the *Timeliidæ*,—they have neither the external structure nor the habits of the typical members of this family; but the tendency of the author of the "Catalogue of Birds" has been to relegate to this family any bird which cannot well be placed elsewhere in the Turdiform section of the *Passeres*, until it has become an unwieldy and somewhat heterogeneous one. The position of *Accentor* in this family has been unfavourably commented upon, and I cannot but think that *Ephthianura* is equally out of place in it.

As a matter of fact, this is one of the most puzzling forms in the whole list of Australian avifauna; and to the cabinet naturalist, who has not the advantage of observing its habits, its true position must be very difficult to determine. Its straight compressed bill, devoid of any notch at the tip, and its somewhat lengthened and slender legs, with a moderately long hind toe and claw, recall, to some extent, the pipits and wagtails, to some of which latter birds its plumage has a resemblance. The wing is, however, thrush-like, straight and pointed, and with a diminutive first-primary, which at once removes the bird from the 9-quilled Passeres, among which the wagtails take their place. To determine, therefore, its position among the 10-quilled Passeres, we must call to our aid the testimony furnished by its habits. Its actions and deportment, and its flight, in a small degree, are chat-like. It frequents low ground in open places, and perches on the tops of low bushes, or on a fence or mound, from which it often gives forth its singular little note; but nevertheless there is wanting the motion of the tail, which is a characteristic of the more-typical chats. Notwithstanding the absence of this feature, however, it would seem to be

allied to the *Saxicolidæ*, a group which some systematists place with the warblers, and others next to them. Its structural characteristics, above alluded to, combined with its chat-like habits, lead to this conclusion, and I have therefore located it with the *Sylviidæ*, or Warblers; but, at the same time, on account of its somewhat aberrant features, placed it a distinct sub-family—*Ephthianurinæ*.

The sub-family comprised three species, appertaining to the genus Ephthianura. They are—*E. albifrons*, Jard. and Selby; *E. aurifrons*, Gould; *E. tricolor*, Gould; all three being more or less migratory. Our bird, *E. albifrons*, arrives here in September, commencing to breed soon after its appearance, and departs in March. It is not uncommon in the Hobart district; but, singularly enough, it has not been recorded from the North, past which it must migrate to come here.

PLATE A.—LEAF IMPRESSIONS FOUND IN THE TURRITELLA SANDSTONE BEDS AT TABLE CAPE.

Fig. 9, 9A, 9B.—*Pteris* (?) *Belli.* R. M. Johnston. Imperfect fragments of a small species of fern referred provisionally to the genus *Pteris.* Frond minute, evidently linear-lanceolate; pinnate or pinnatifid; rachis strongly marked; pinnules simple, minute, ovate, opposite or alternate, attached to rachis by the entire base, gradually reduced in size and more obtusely rounded towards base and apex of frond.

Figs. 1-6, 8, 8A, 10-13.—Leaf impressions undetermined, associated with *Pteris Belli.*

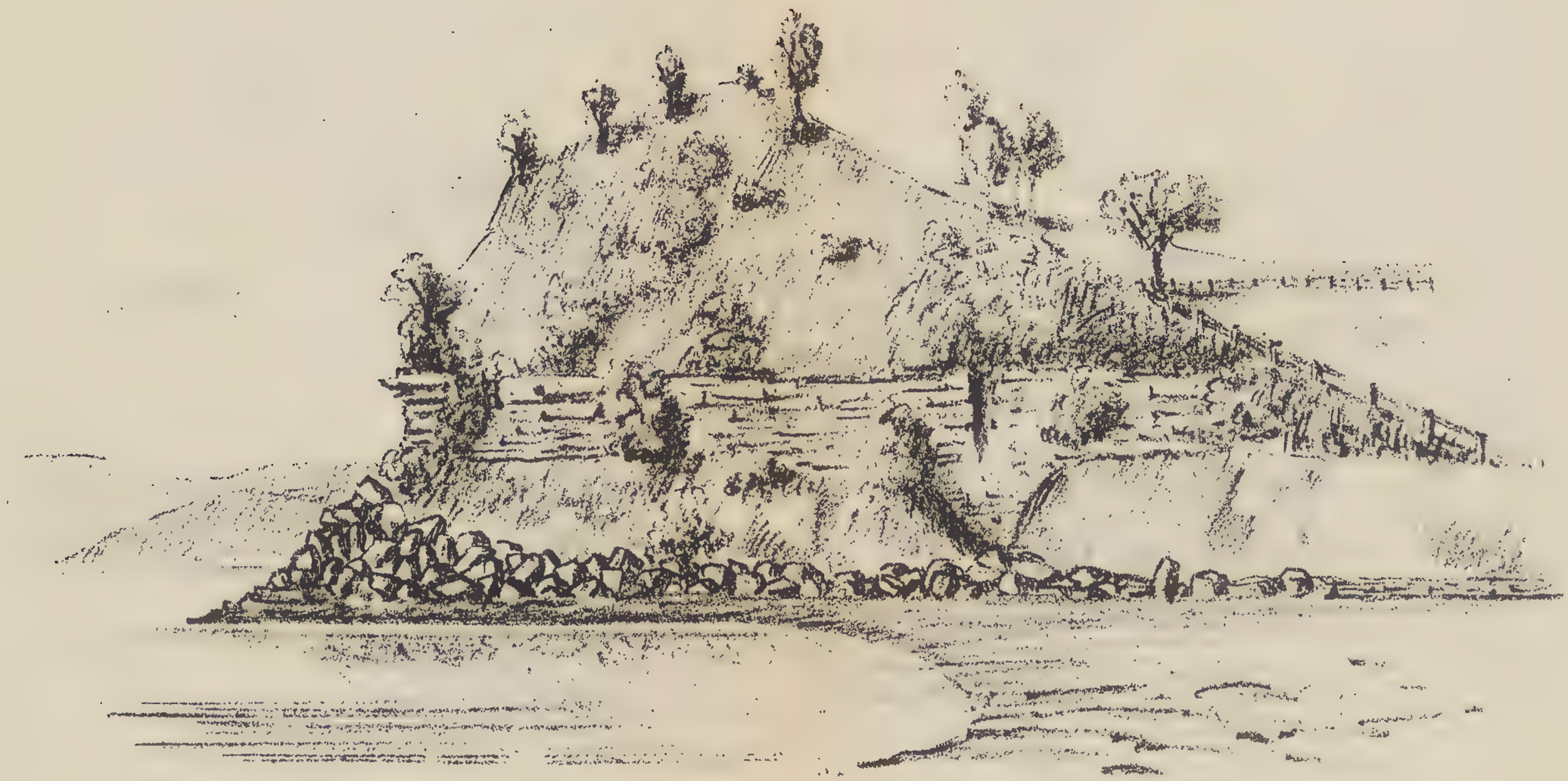
Fig. 7.—*Sapotacites oligoneuris.** Ettingshausen. Ditto, ditto.

PLATE B.—Diagram of tertiary beds as exposed in cliffs at Sandy Cove, Table Cape. It is from the uppermost or turritella zone where the leaf impressions were obtained. The marine beds are capped by basalt.

* This form also occurs in the tertiary leaf beds at One Tree Point and Pipeclay Bluff, near Hobart; also in similar deposits at Macquarie Harbour.—R. M. J.

NOTE.—All figures natural size.

A.



TERTIARY BEDS, SANDY COVE, TABLE CAPE. B.

ILLUSTRATED KEY TO GENERA OF TASMANIAN MOSSES.

By R. A. BASTOW, F.L.S.

No.	Species	Genus and characters
1.	A. petrophila ...	ANDREÆA—Capsule bursting by four lateral slits ...
2.	P. gracilentum ...	PHASCUM—Capsule bursting irregularly ...
3.	B. minuta... ...	BRUCHIA—Capsule bursting irregularly, furnished with an apophysis ...
4.	S. contortum ...	SPHAGNUM—Capsule sessile on a short white receptacle ...
5.	P. pyriforme ...	PHYSCOMITRIUM—Capsule obovate or clavate; operculum conical, leaf cells large, lax ...
6.	E. australis ...	ENCALYPTA—Capsule cylindric; beak of operculum straight. Calyptra very large ...
7.	M. pusilla ...	MACROMITRIUM—Capsule ovoid, grooved. Calyptra plicate, laciniate at the base...
8.	H. ciliata ...	HEDWIGIA—Capsule globose, sessile amongst the perichætial leaves ...
9.	H. Humboldtii ...	HEDWIGIA—Stems ½in. to 2in. long. Fruitstalk short. Operculum beaked ...
10.	B. Humboldtii H. Humboldtii	BRAUNIA—Stems 2in. to 6in. long. Fruitstalk long, slender. Operculum beaked ...
11.	L. repens ...	LEPTANGIUM—Stems ⅛in. to ¼in. long. Fruitstalk none. Operculum scarcely beaked ...
12.	L. Menziesii ...	LEPTOSTOMUM—Mouth with a membranous ring. Leaves piliferous; cells large, lax ...
13.	G. calcareum ...	GYMNOSTOMUM—Mouth without a membranous ring. Leaf cells minute, capsule erect, ovoid, not grooved. Operculum with an acute inclined beak... ...
14.	Z. cyathicarpus ...	ZYGODON—Mouth without a membranous ring. Leaf cells minute. Capsule erect, ovoid grooved or striate. Operculum with an acute inclined beak
15.	D. nervosus ...	DESMATODON—Mouth without a membranous ring. Leaf cells minute. Capsule sub-erect, ovoid oblong, smooth. Operculum hardly beaked. Nerve of leaf very thick ...
16.	M. microphyllum...	MACROMITRIUM—Capsule ovoid. Calyptra laciniate at the base ...
17.	P. serratum ...	PTYCHOMITRIUM—Calyptra laciniated at the base, shorter than the capsule ...
18.	O. luteolum ...	ORTHOTRICHUM—Capsule pyriform. Calyptra crenate at the base, usually very hairy ...
19.	G. apocarpa ...	GRIMMIA—Calyptra split at the base ...
20.	R. symphyodon ...	RACOMITRIUM—Calyptra fringed at the base ...
21.	L. inclinans ...	LEPTOSTOMUM—Peristome a membranous ring... ...
22.	E. gracilis... ...	ENTOSTHODON—Teeth erect when dry ...
23.	S. octoblepharum	SPLACHNUM—Teeth recurved when dry, apophysis sometimes larger than the capsule ...
24.	Z. intermedius ...	ZYGODON—Teeth recurved when dry. Capsule grooved ...
25.	W. flavipes ...	WEISSIA—Teeth erect or recurved when dry. Capsule not grooved. Perichætial leaves short
26.	S. perichætialis ...	SYMBLEPHARIS—Teeth incurved when dry. Capsule not grooved. Perichætial leaves very long, sheathing the fruitstalk ...
27.	B. acuta	BLINDIA—Capsule erect, fruitstalk short ...
28.	C. pusillum ...	CONOSTOMUM—Capsule globose, inclined; mouth small; teeth 16, united at tips. Leaves subulate, serrate ...
29.	D. nervosus ...	DESMATODON—Leaves broad, soft, papillose at the back, nerve very thick. Teeth 16, 2-3 fid ...
30.	D. papillatus ...	DIDYMODON—Leaves narrow. Teeth 16 or 32, lanceolate, entire, 2 fid or perforate, fragile, irregular ...
31.	D. capillaceum ...	DISTICHIUM—Leaves narrow, distichous. Teeth 16, equidistant ...
32.	T. australe ...	TRICHOSTOMUM—Leaves narrow. Teeth 16, perforated, or 32 in pairs, slender, erect, of one series of cells ...
33.	T. cuspidata ...	TORTULA—Leaves broad or narrow. Teeth 32, slender, twisted, of two series of cells ...
34.	C. purpureus ...	CERATODON—Stems erect. Teeth 32, united by trabeculæ ...
35.	L. candidum ...	LEUCOBRYUM—Stems erect. Teeth 16, 2 fid. Leaves thick, white, spongy ...
36.	D. Sieberianum ...	DICRANUM—Stems erect. Teeth 16, 2 fid. Leaves of ordinary texture ...
37.	C. torquatus ...	CAMPYLOPUS—Capsule ovoid, furrowed. Calyptra fringed at the base. Teeth 16, 2 fid ...
38.	T. flexipes ...	TREMATODON—Capsule pyriform, with a long narrow struma. Calyptra inflated. Teeth 32, granulate ...
39.	M. Eskloni ...	MIELICHOFERIA—Capsule pyriform, with a tapering struma. Calyptra small, narrow, Teeth 16, connate at the base ...
40.	P. commune ...	POLYTRICHUM—Stout erect rigid mosses. Leaves usually lamellate, brown or livid green ...
41.	D. superba ...	DAWSONIA—Capsule horizontal, flat above, convex below. Teeth innumerable, forming a filiform brush ...
42.	M. plumula ...	MNIOPSIS—Areolation hexagonal, calyptra small... ...
43.	M. Brownii ...	MACROMITRIUM—Calyptra not inflexed, but laciniate at the base ...
44.	O. crispum ...	ORTHOTRICHUM—Calyptra (usually very hairy) not inflexed, crenate or split at the base ...
45.	B. Halleriana ...	BARTRAMIA—Capsule globose, furrowed; operculum nearly flat ...
46.	Z. Drummondi ...	ZYGODON—Leaves short, entire; cells minute. Capsule erect, ovoid, grooved. Outer teeth recurved when dry
47.	C. Menziesii ... *Z. Drummondi* ...	CONDONBLEPHARUM—Internal peristome forming a bell-shaped elevation ...
48.	F. crispula ...	FUNARIA—Leaves flaccid; cells large, lax. Capsule pyriform, inclined or pendulous, mouth small, teeth horizontal ...
49.	A. Gaudichaudii ...	AULOCOMNION—Capsule narrow, cylindric, furrowed ...
50.	L. Gaudichaudii ... *A. Gaudichaudii* ...	LEPTOTHECA—Capsule cylindric, erect, equal *(Aulocomnion Gaudichaudii)*
51.	O. australe ...	ORTHODONTIUM—Capsule oblong, furrowed ...
52.	B. lanceolatum ...	BRACHYMENIUM—Capsule clavate, pyriform not furrowed ...
53.	L. pyriforme ...	LEPTOBRYUM—Annual, leaves almost setaceous ...
54.	B. Billardieri ...	BRYUM—Shoots from the sides or tops of the stems. Operculum shortly beaked or not beaked ...
55.	B. (? Tasmanica) ...	BUXBAUMIA—Capsule plain, convex, outer peristome irregular ...
56.	F. pallidus ...	FISSEDENS—Teeth 16, 2 fid, spreading when dry. Leaves distichous, equitant ...
57.	H. piliferus ...	HYMENODON—Calyptra cucculate. Teeth 16, membranous, united at the base. Leaves piliferous, papillose ...
58.	F. adiantioides ...	FISSEDENS—Calyptra cucculate. Teeth 16, 2 fid, red. Fruitstalk moderate... ...
59.	C. (? ciliata) ...	CATHAROMNION—Calyptra mitriform, lacerate at the base. Stems elongate, fruitstalk short ...
60.	H. (? ciliatum) ... *Catharomnion* ...	HYPOPTERYGIUM—Calyptra mitriform, lacerate at the base. Teeth 16, membranous, united at the base. Leaves ciliate ...
61.	L. lagurus... ...	LEUCODON—Teeth 16, 2-3 partite, united at the base ...
62.	N. pennata ...	NECKERA—Leaves distichous, oblique, broad, shining. Capsule erect... ...
63.	T. planifolium ...	TRACHYLOMA—Leaves distichous, not oblique, serrate. Capsule erect ...
64.	O. falcifolia ...	OMALIA—Stems prostrate or creeping. Leaves distichous, capsule cernuous or horizontal ...
65.	L. imbricata ...	LESKIA—Leaves spreading, inner peristome usually without intermediate cilia ...
66.	R. bifarium ...	RHIZOGONIUM—Stems erect, hardly branched. Leaves distichous, strongly serrate, capsule inclined. Fruitstalk from the base of the stem ...
67.	H. Smithianum ...	HYPOPTERYGIUM—Stems dendroid, much branched. Leaves tristichous. Capsule sub-erect, cernuous, or pendulous ...
68.	L. pallens... ...	LOPIDIUM—Stems elongate, pinnately branched above, fruitstalk short ...
69.	H. politum ...	HYPNUM—Stems creeping or prostrate. Leaves distichous, piliferous, nerveless. Capsule cernuous ...
70.	C. setosum ...	CYRTOPUS—Stem erect, capsule not furrowed. Leaves with a stout nerve ...
71.	C. sciuroides ...	CLADOMNION—Rhizome creeping. Capsule erect, furrowed. Leaves nerveless or two nerved ...
72.	M. filipendulum ...	METEORIUM—Rhizome creeping. Stems pendulous, very long (M. nitens). Leaves shining, membranous concave. Capsule erect ...
73.	I. comosum ...	ISOTHECIUM—Habit dendroid. Stems apparently naked below, above pinnately or verticillately branched. Capsule erect or inclined by the curvature of the fruitstalk ...
74.	H. cochlearifolium	HYPNUM—Stems creeping or prostrate, pinnately or vaguely branched. Capsule curved, horizontal, or pendulous, not furrowed. Calyptra glabrous ...
75.	R. sub-basilare ...	RHIZOGONIUM—Stems erect, simple. Leaves strongly serrate. Fruitstalk from the bases of the stems. Capsule inclined ...
76.	R. cristatum ...	RACOPILUM—Stems creeping, branched. Leaves piliferous. Capsule curved, furrowed, cernuous. Calyptra hairy ...
77.	C. Tasmanica ...	CRYPHÆA—Stem erect or pendulous, branched. Leaves imbricate all round the stem. Capsule erect, sunk in the perichætial leaves ...
78.	C. pennata ...	CYATHOPHORUM—Stems erect, unbranched. Leaves tristichous, dorsal small. Capsule erect, almost sessile ...
79.	R. australe ...	RACOPILUM—Stems creeping, branched. Leaves obscurely tristichous, piliferous. Capsule curved, grooved. Calyptra hairy ...
80.	H. concinnum ...	HYPOPTERYGIUM—Stems dendroid. Leaves tristichous, dorsal smaller. Capsule sub-erect, cernuous or pendulous ...
81.	H. crispula ...	HOOKERIA—Stems sub-erect or creeping. Leaves more or less distichous; cells large, lax. Capsule cernuous. Teeth with transverse bars ...
82.	D. pusilla	DALTONIA—Stems erect, tufted. Leaves imbricate all round. Capsule erect ...

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